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Child Behavior, Animal Behavior, and Comparative Psychology

EDITED BY

CARL MURCHISON

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THE DAILY MATURATION OF INFANT BEHAVIOR: A CINEMA STUDY OF POSTURES, MOVEMENTS, AND LATERALITY

Clinic of Child Development, Yale University

ARNOLD GESELL AND HENRY M. HALVERSON

A. INTRODUCTION

The underlying data of the present study are in some ways unique. They consist of 220 daily cinema records of Infant M.H., covering the period between the 15th and the 235th day of age, supplemented by weekly records for the remainder of the first year of life. The records were made under well standardized conditions in the infant's own home, and therefore have a high degree of external experimental control. Artificiality was reduced to a minimum because the daily photographic experience became a pleasant event in the domestic routine of a normal and extremely coöperative subject. All of the basic records were made under the domestic rooftree. No strangers intruded. Additional cinema records of developmental examinations at monthly intervals were made at the Yale Clinic of Child Development.

The findings of our investigation were derived almost entirely from the cinema records which were minutely inspected and quantified by the method of cinemanalysis.[1]

The photographic setup (Figure 1), briefly described below, was located in the child's bedroom. Divestment of clothes and the radiant warmth of the photographic lamp in addition to the agreeable associations of the experience gave continuity to the emotional controls of the exeprimental situation. The subject was in excellent health during the entire period of this investigation.

The photographic setup consisted of (*a*) a filmo automatic camera equipped with a 15 mm. lens and enclosed in a nearly sound-proof box; and (*b*) a cubicle three feet square at the top and bottom, and four feet high. The frame-work of the cubicle consisted of four

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[1]The authors are extremely indebted to Mrs. L. B. Ames for her assistance in this analysis and for the preliminary tabulation of the data.

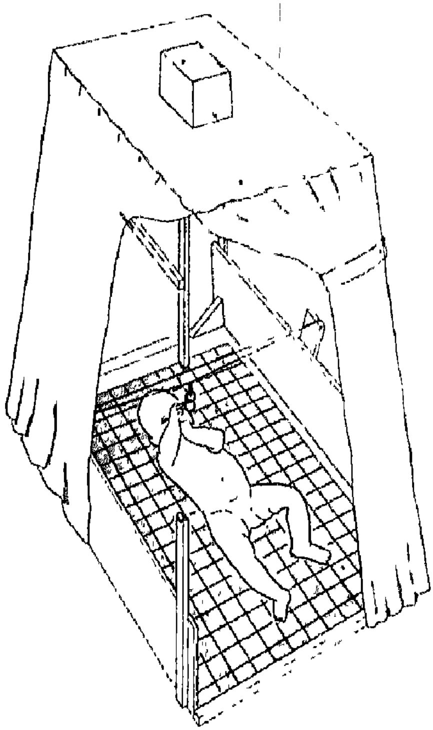


FIGURE 1

sturdy wooden legs, on the top of which was a platform or roof with a hole at its center. The legs were braced at the bottom by means of two baseboards 12 inches high, one at each side of the cubicle. A screw-eye was attached to the top of each baseboard midway of its length. A grey cloth curtain supported from the roof-platform completely enveloped the four sides of the cubicle when the experiment was in progress. The box containing the camera rested on top of the cubicle with the lens pointing directly at the subject's umbilicus. The floor of the cubicle was covered with a pad; on top of the pad was a grey blotter marked off into two-inch squares. Adequate illumination was provided by a photo-flood lamp above the feet of the subject and out of range of her vision.

The subject, M.H., was undressed by her mother and placed supine midway on the floor of the cubicle, umbilicus directly under the camera and invariably over a certain point in the squared-off blotter. The background of squares also served to define the cinem-analysis of the photographic records. The experiment always started at 5:30 P.M.

Three behavior situations, each approximately 10 seconds in length, were recorded at each session as follows:

1. *The anthropometric or "full length" situation* in which the mother briefly held the child's head and ankles to induce a full length posture for the record. This situation always occurred at the beginning of the session.

2. *Moving ring situation.* Three interlocked red, white and blue plastic rings (4 cm. in diameter) were moved horizontally across the field of vision to the child's left and then back to her right. Each transit took 5 seconds; 10 seconds in all.

3. *Still ring situation.* Perceptual and postural reactions to these same rings. The rings were suspended from a cord strung between the screw-eyes attached midway along the top of the baseboard; they dangled directly above the child's chest in a stationary position within easy reach.

It is of interest to note that after the child was able to creep, at about nine months of age, as soon as the lights in the cubicle were turned on, she often crept spontaneously into the cubicle and lay down in very nearly the correct position, with her head at the correct end of the cubicle. This behavior reflected her full acceptance and

even enjoyment of the situation. Throughout the whole study no resistance was encountered except in the anthropometric situation and then only for a limited period from the 16th to the 61st day. This situation obliged the mother to turn the infant's head from the preferred averted tonic neck reflex position to a midposition, to secure a frontal photographic record. The momentaiy constraint caused crying. Aftei the 61st day all crying ceased. Why? Because the infant was conditioned? Or because by this time the greater maturity of the neuro-motor system made the midposition of the head more "natural," that is spontaneous and therefore unconstrained? The present study will consider the morphogenetic significance of such maturational and environmental factors.

B. Head and Eye Behaviors

1. *Head Postures*

Neuro-motor organization proceeds in a cephalo-caudad direction. The findings of our study, accordingly, will be summarized in the following order: (*a*) head and eye behaviors; (*b*) arm behaviors; (*c*) leg behaviors.

On the first two sessions of this study, namely the 15th and 16th days, head postures could not be observed to advantage. The infant was active and seemed unadjusted to the novel situation of the photographic cubicle. By the third session, however, namely Day 17, she was relatively quiescent. She spontaneously assumed a tonic-neck-reflex attitude (*t-n-r*)—head averted and arm extended to one side, the contralateral arm flexed at the shoulder. Other studies (5) have shown that this is a well nigh universal postural attitude at this stage of development. M. H. maintained the attitude daily from 6 per cent to 100 per cent of the recorded cinema time from Day 17 to Day 82. Out of a total of 834 seconds, 372 or 44 per cent were spent in *t-n-r*. A more comprehensive discussion of this important tonic-neck-reflex pattern is deferred to a later section.

The cinema records show that only on one day for one per cent of the time the child assumed a leftward *t-n-r*. On all other days the *t-n-r* was rightward, which leaves us with the striking generalization that for 65 successive days even under the stress of the stimulus of rings moving across the field of vision the head posture remained consistently averted toward the right. There was no external stimulus

which could bring about this orientation. The determining intrinsic stimulus factor was so strong that the head maintained its rightward orientation even after brief ocular pursuits of the ring momentarily diverted the head through a small arc toward the left. These eye movements, unquestionably determined by the visual stimulus, showed an increasing degree of emancipation from the postural set of the head. In due time (at about the 70th day) the head posture showed a similar independence. With the acquisition of free head mobility the eye posturing assumed a dominant rôle in determining the head posturing.

On the 84th day the moving ring stimulus was supplemented with a still ring stimulus. It will be recalled that the moving rings made one complete transit from right to left and return in 10 seconds of time. In the still ring situation the same rings hung suspended in the midline for 10 seconds. The accompanying graph (Figure 2) shows

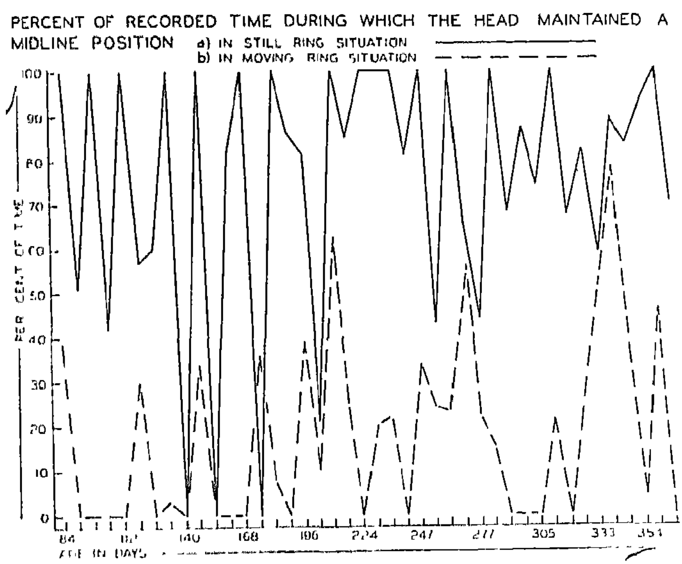


FIGURE 2

the per cent of cinema recorded time in which the head assumed a midposition both in the moving ring and the still ring situation. When the head movements are fully emancipated the visual stimuli

exert the decisive influence on head posture. Averages calculated on a weekly basis show that for 77 per cent of all available time in the still ring situation (when the stimulus was in the midline) the head too was in midposition, as contrasted with 19 per cent of the time when the rings moved across the field of vision. It is significant that there are no striking changes with age. From the 82nd day to the 365th even a familiar visual stimulus continued to determine head posture.

Posture may be static or dynamic. The present section has dealt chiefly with static posture or postural fixation. This fixation consisted of relatively stabilized head attitudes by means of which the child achieved sufficient steadiness to accomplish his visual-perceptual adjustments. Dynamic postures produce characteristic head movements.

2. *Head Movements*

Head movements were identified through the method of cinemanalysis. The simplicity and uniformity of the experimental setup enabled the analyzer to assess with fair precision the head orientations and translations in terms of degrees on an arc of 180°.

Significantly enough the most interesting findings concerning head movements were elicited by the *still* ring situation, which released "natural" head movements which were so deep-seated that they apparently disdained the stationariness of the focal stimulus.

The tabular summary of Table 1 outlines the various types of these irrepressible head movements.

TABLE 1
HEAD MOVEMENTS IN STILL RING SITUATION

Day	Week	Behavior
84-105	12-15	Starts in midline, turns to about 45° right, then back to midline.
112-126	16-18	Varies. Quiescent in midline; active rotation to both sides; midline to 45° right.
133-224	19-32	Mostly quiescent in midline.
231-263	33-38	Same, though eyes are very active.
270-277	39-40	Head active, flexes and extends.
291-305	41-43	Midline. Turns 45° right, then back to midline or a little past.
312-326	44-47	Head mostly in midline. Flexes and extends a little.
333-347	48-49	Midline. To 20-45° left. Back to midline.
354-361	50-51	Maintains in midline.
365	52	In midline Way to left. Way to right. To midline.

A complete and perfect fixation upon the rings would have abrogated all of the movements above noted. Superficially the movements seem non-adaptive; developmentally they are evidences of maturing control. Antagonistic movements are being progressively organized, in accordance with the principle of reciprocal neuro-motor interweaving (6). The trend is toward balanced bilateral facility of eye movements, but there is a strong rightward dominance correlated with the rightwardness of the underlying tonic-neck-reflex pattern.

This neuro-motor preference for the right sectors is a symptom of a deep-seated laterality which is also manifested in the *moving* ring situation (see Table 2). Here again there is a morphogenetic drag

TABLE 2
HEAD MOVEMENTS IN MOVING RING SITUATION

Day	Week	Behavior
15-63	2-9	Quiet in right rotation, 90° right.
70-90	10-14	From extreme right rotation to about midline.
112-242	16-34	Rotates from extreme right to about 120° from this, that is to a little left of midline. Eyes follow rings rest of way. Then back to original position.
247-333	35-47	Starts either in midline or 45° or less to right of midline. Follows to 10° to 20° past midline and then back to 45° right of midline. (After day 298 this movement often precedes or follows movement of rings).
340-347	48-49	Starts about 30° right of midline. To midline then flexes forward.
354-365	50-52	Same as 247-333.

to the right, both head and eye movements favoring the right quadrant. But as the child matures (after the 112th day) there are widening excursions into the left quadrants. The eyes because of their more precocious emancipation surpass the head in these excursions. The head may move from extreme right through 120° toward the left but the eyes in their pursuit of the rings will make the full pursuit of 180°. The synchronization and coördination of eye movements and head movements change with the maturation of the controlling neuro-motor systems, but the eyes maintain an ontogenetic lead.

The development of head movements requires facility in the sagittal plane as well as in lateral planes. Accordingly the cinema records show the intrusion of extensor and flexor head movements both in the still and moving ring situations during the period between 270

and 347 days. These novel movements are non-adaptive, but they have a forward reference in the developmental economy. Inasmuch as they are not responsive to the immediate external stimulus situation they may be considered to be products of maturation.

Table 2 summarizes the reaction patterns as they emerged on cinemanalysis. The table suggests increasing sophistication in infant M. H. At an immature stage her pursuit of the moving rings started from a naïve full right position. Later on (by the 35th week), she started her ocular pursuit either at the midline or at 45° or less to the right of the midline. This apparent sophistication, however, may be a function of her neuro-motor maturity rather than a deposit of her experience. Her neuro-motor structures are now so advanced in their organization that the midline is the convenient starting point for active inspection. She is older rather than wiser.

3. *Relative Regard for Still Rings and Moving Rings*

The cinema records made it possible to ascertain to a fraction of a second the amount of available time which was each day expended on the still rings and on the moving rings. The accompanying graphs (Figures 3 and 4) plot the distribution and amount of regard on a

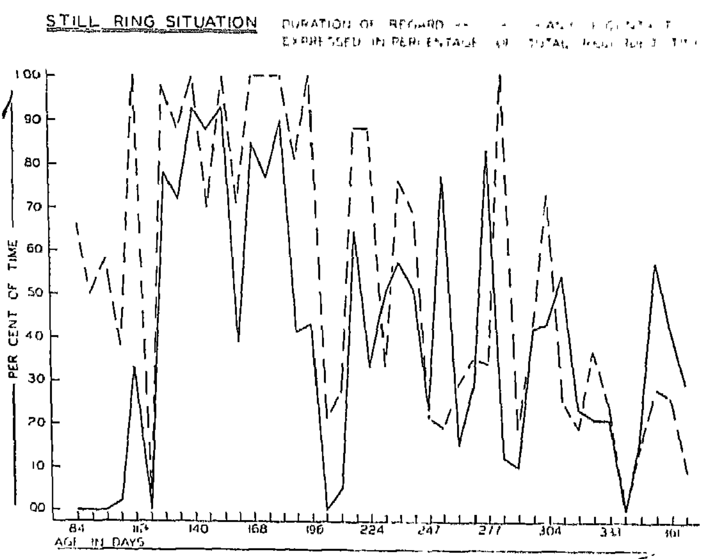


FIGURE 3

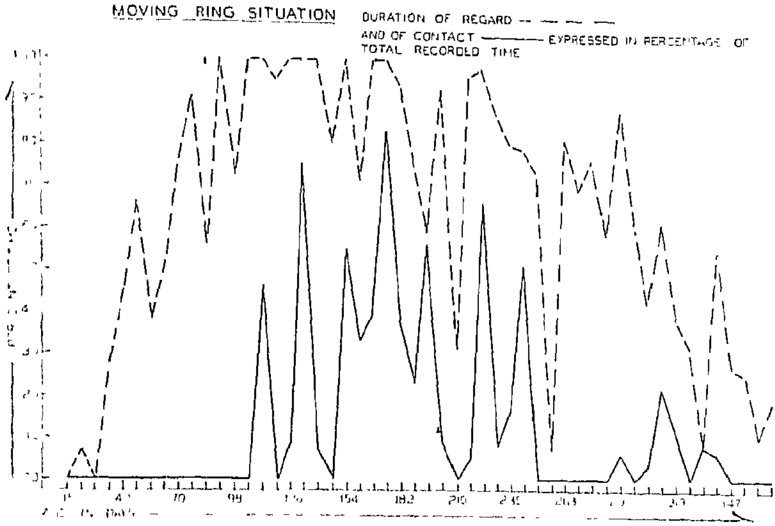


FIGURE 4

percentage basis, the dotted lines representing the amount of regard for the still rings (Figure 3) and for the moving rings (Figure 4). The general level of this visual attention is high and is represented by a percentage range of from 75 to 100 per cent for most of the period from the 84th day to the 182nd day. This apparently coincides with the period when the child is completing the early rapid growth of the ocular-motor equipment and when "visual hunger" is at its height.

The general configuration of the curves is very similar. As the child grows older there is a fairly steady dropping off of the total amount of visual attention. This trend is reflected in Table 3 which lists the average percentage of regard for the moving and still rings for the three age periods 84 to 182 days; 189 to 291 days; 298 to 365 days. In all of these age periods the moving rings get the preponderant regard (Table 3).

TABLE 3

AMOUNT OF REGARD FOR STILL AND MOVING RINGS

Day	Still rings	Moving rings
84-182	76%	94%
189-291	52%	72%
298-365	27%	35%
Average	52%	67%

In interpreting the percentage graphs the question of maturation and learning again comes into relief. If the daily repetition of the visual stimulus had a progressive or cumulative habituation effect, the total amount of regard would maintain or increase its level. The opposite happens. There is a distinct downward trend which probably is due to the fact that visual interest ramifies, fluctuates, and abates after a function has become perfected.

4. *Regard for Still and Moving Ring Compared with Contact of Rings*

Because of the cephalocaudad directionality of development the infant lays hold of the physical universe with his eyes before he does so with his hands. The goal of development is a coördination of ocular and manual grasping. But in this coördination the eyes as previously noted take the lead. The absolute and relative amounts of regard have just been recapitulated.

In a similar way physical contact and manipulation of the rings were calculated. It is now possible to bring these percentage values into comparison both for the still and moving ring situations. The two accompanying graphs (Figures 3 and 4) sum up the comparison.

In the still ring situation contact and regard not only occur to about the same extent, but the graph lines follow quite closely the same pattern. For the whole period from 84 to 365 days the average amount of regard is 52 per cent, of contact, 40 per cent.

The moving rings present interesting differences. For the same period from 84 days to 365 days the average amount of regard is 67 per cent, the average amount of contact is 16 per cent. Visual regard was present from the beginning. Manual contact occurred for the first time on day 105. Thereafter the amount of contact varied markedly from 0 per cent to 87 per cent averaging around 50 per cent until Day 242. After that there was practically no contact. Regard, on the other hand was well sustained throughout, and during the visual heyday, from Day 84 to Day 182, the amount of regard was frequently from 80 per cent to 100 per cent.

Evidently the factor of movement increases visual interest. The moving rings attract more and earlier regard than do the still rings, but the still rings attract more, earlier, and longer contact. It is interesting to note that the highly exceptional failure to regard the

still rings on Day 119 was due to a preoccupied visual interest in the newly discovered hands. M.H. contemplated her hands throughout the whole still ring situation.

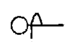
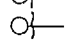
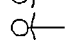
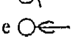
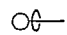
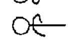
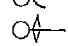
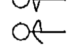
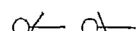
C. Arm Behaviors

1. *Arm Postures*

Cinema records for still and moving rings and for the anthropometric situation were analyzed to determine typical arm postures. The method of analysis was the same as that used for typical head postures. The most representative record for a given week was subjected to detailed analysis. The films were inspected in motion, and where stilled at empirically determined intervals to secure a tracing of the salient phases in postural pattern. In a series of phases it was always possible to select one which typified the most characteristic postural pattern for the week in question. These typical posturings were then arranged in chronological order to determine trends, chiefly with respect to the most representative static posture, by which is meant a postural fixation or a spontaneously assumed motor attitude prior to an active postural response.

When reviewed in the total ontogenetic array from the 17th day to the 365th, 11 distinguishable intervals became apparent (Table 4). These intervals were based entirely on pattern characteristics and varied with respect to chronological length. The intervals as

TABLE 4
SUMMARY OF ARM POSTURES (FULL LENGTH AND STILL RINGS)

Stage	Days	Weeks	Behavior	
1	17-58	2-7	Unilateral flexion, *t-n-r*	
2	60-63	8-9	Bilateral extension, shoulder height	
3	70-79	10-11	Bilateral extension a little lower	
4	98-133	14-19	Bilateral extension way down at side	
5	147-154	21-22		
6	161-182	23-26	Bilateral flexion	
7	189-214	27-30	One extended; one flexed	
8	222-235	31-33	Bilateral flexion	
9	235-270	33-39	One extended; one flexed	
10	284-291	40-41		
11	298-365	43-52	Bilateral extension. (Batting)	

outlined below are equivalent to stages. Needless to say there are no abrupt cleavages. Nevertheless there are unmistakable trends in the 11 successive stages.

The nature of the trends is summarized in the pictograms. From the second to the seventh week the classic tonic-neck-reflex posture is predominant. In M.H. it was emphatically a rightward *t-n-r*, the right arm being in full extension, the left flexed at the shoulder, the head averted to the right. In the next two weeks this asymmetry is displaced by bilateral extension of the arms at shoulder height. The symmetry is induced by the midline position of the head which is no longer averted.

In the next two weeks the neuromotor transformations involve particularly the shoulder girdle in such a way that the arms, which were previously at right angle lateral extension come obliquely toward the flanks. The downward migration is completed by about the 20th week. In these early stages the postural orientations tend to involve the arm as a single extended unit.

From the 23rd to the 26th week this extension gives way to bilateral flexion at the elbow. Bilateral symmetry never proves to be the goal or end-station of postural development. The infant's motor economy requires asymmetric and alternating postural fixations and movements. Between the 27th and 30th week accordingly, bilateral flexion gives way to a combination of unilateral flexion and unilateral extension. In obedience to the rightwardness of the early *t-n-r*, the extension is most conspicuous in the right member.

The cycle of neuromotor organization, however, is by no means completed. Symmetry and asymmetry must be brought into more advanced reciprocal relationships. The asymmetric Stage 7 therefore gives way to a temporary stage (31-33 weeks) of bilateral extension, reminiscent of Stage 4, but on a higher level of maturity and complexity. This higher level proves to be transitory. From the 33rd to the 39th weeks the representative posture is flexion of the left, extension of the right member.

The new complexities involve the trunk musculature to an increasing extent. They also involve the leg posturings. The pictograms oversimplify the concealed mechanisms but they are faithful to the directional trends. As the infant enters the creeping stage in her locomotor development, the asymmetric postures become less

static; they are energized by propulsive impulses. The terminal or 11th stage (43rd to 52nd week) is characterized by a basic bilateral extensor attitude which breaks into alternating propulsive movements, —resulting in a forward batting of the rings. Turn this infant on her stomach and these aerial movements make terrestrial contact for forward locomotion. The fact that they assume such consonance of pattern, whether the infant is prone or supine, reflects the intrinsic nature of the morphogenetic determinants.

2. *Arm Movements*

The foregoing section outlined the general trend of the ontogenetic changes in typical postural set of the arms. Dynamic posture consists in translations and readaptations of postural set for the execution of spontaneous or adaptive movements. These movements of the arms were meticulously studied by the method of cinemanalysis, both for the still and the moving ring situations. Each daily record was inspected separately in serial sequence. As soon as a definite variation in pattern disclosed itself the records were reviewed for adjacent days to determine the permanence and characteristicness of the newly discovered pattern variant.

The arm movements were not identified on the basis of visual-manual adjustment to the stimulus object. In making a prehensory approach the infant tended to use or manifest the form of movement which was natural to her at that stage of maturity. It is this natural movement with which we are concerned.

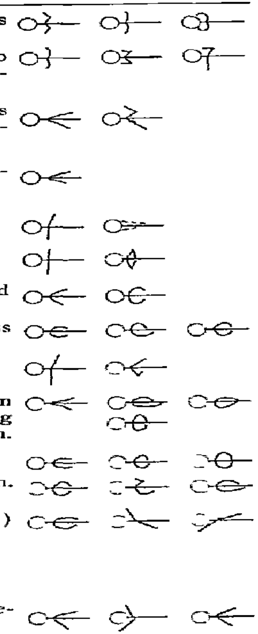
This empirical method proved effective and resulted in a classification of 14 consecutive stages which held for both the moving ring and still ring situations. The classification of stages was confirmed by an independent observer who studied the records in similar detail.

The stages are characterized in Table 5, embellished with pictograms.

A consecutive perusal of the arm movement sequences brings into view the phenomenon of reciprocal interweaving (6). Adjacent stages frequently show differences in form rather than magnitude. When the total map of behavior is surveyed it is possible to pick out strands or trunk lines of development which show consistency of direction. Reciprocal interweaving is more conspicuous than simple incrementation. When the interweaving is envisaged in terms of two

TABLE 5
SUMMARY OF ARM MOVEMENTS (Moving Rings, 14-105 days)
(Still Rings, 106-365 days)

Stage	Days	Weeks	Behavior
1	15-21	2-3	Jerky bilateral extension inward, horizontal. Hands meet. (H)
2	23-39	3-5	With vertical flexion, bilateral and then resolves into *t-n-r*. Arms start *at extension* at or above shoulders. (V, H)
3	40-83	6-10	Arms extended increasingly lower, left arm flexes vertically into *t-n-r*, right arm extends. Unilateral. (V, H)
4	84-105	12-15	Arms extend down at sides, though left arm sometimes flexes up a little. (V)
5	*105-112 142-156	15-16 20-22	Bilateral extension insweep. (H)
6	128-134 168-171	18-19 24	Bilateral extension insweep, then *flexion*. (H)
7	136-141	19-20	Bilateral upsweep (V) across body, palms toward chest.
8	165-168 172-188	23 25-27	Unilateral, at least one at a time, upsweep across trunk. (V)
9	168-171 195-201	24 28	Unilateral insweep, backs of hands up. (H)
10	208-218 235-256, ff	29-31 33-37, ff	Unilateral in and up with accompanying forearm rotation (HV). A two-part movement becoming smoother. At first bends up on self and comes in.
11	222-234	31-33	Bilateral in and up, at an angle. (HV)
12	225-230 247-291	32-33 35-41	Unilateral, bends up on self then sweeps in or down.
13	151-161 187-212 242-256 276-284 333-365	21-23 27-30 34-37 39-40 47-52	Unilateral extensor *batting* or *pullings* at *rings*. (V)
14	219-221 291-312 326 361	31 41-44 46 51	Bilateral extensor *batting*, *alternately* or *simultaneously*. (V)



*Note that many behaviors appear for a few days and then drop out, and then reappear.

reciprocals, namely alpha and beta, it will be found that the alpha′ and alpha″ continuity constitutes one strand of development and beta′ and beta″ etc. constitutes another strand. It is for this reason that alternate stages appear more consistent than adjacent stages.

Figure 5 illustrates the reciprocal interweaving which occurs in the development of arm movements. It presents graphically the manner in which four of the outstanding *trends* of arm behavior develop during the first year. The four trends shown are:

1. Arms at shoulder height, move inward
   a. Arms extend as move inward
   b Arms flex as move inward
2. Arms extend downward and then move upward
   a. Arms extend as move
   b. Arms flex as move

Since each of these trends with the exception of 1-*a* expresses itself both in a bilateral and in a unilateral fashion, there are actually seven outstanding trends pictured. The manner in which each of these occurs at an early age, then disappears and recurs at a later age is well illustrated. The graph further illustrates the fact that though individual trends come and go according to the principle of interweaving, the general overall development is straightline, in this case from arms at shoulder height, moving inward in an extensor fashion, to arms extended downward beside the trunk and moving upward in extension.

Summary review of the 14 distinguishable stages discloses a definite trend from jerky quasi-atactic movements toward smooth synergistic performance. This trend, however, is not absolutely straight because the organization of the movements involves four sectors or segments, namely the axial musculature, the upper arm, the forearm, and the hand. These segments are not innervated uniformly at an even rate. The ontogenetic tendency is from proximal to distal and from total movements to discrete movements. The distal segments may at times display a partial independence which seemingly breaks up the continuity of developmental advance.

The general pattern of movements conforms to the static postures outlined in the previous section. Arms are at first flexed at shoulder height, then extended at shoulder height, then finally come to full downward extension parallel to the trunk. The topographic changes

in the arm movements are also reflected in the orientation of the hand in regard to the sagittal plane. In the first stage, the palmar aspect of the hand is in the transverse vertical plane. With the innervation of the forearm and hand there is a trend toward clockwise rotation which brings the palmar aspect of the hands parallel with the sagittal plane. The initial attitude of the hand therefore differs at different stages. The trend may be summed up as an emancipation from restricted plantigrade attitudes toward mobile and versatile attitudes which make possible facile approach from many different angles. From the standpoint of developmental morphology the motor maturation of the child's arm activities consists in an increasing command of the planes of movement with an increasing diversification of initial stances so that the stimulus object is approached from a large variety of directions.

In working out the time intervals for the 14 stages it was found that in over half of the stages it was necessary to assign two or more age intervals. This was due to the reciprocal interweaving nature of the developmental organization, which is shown graphically in Figure 5.

Incidental behavior. Two frequent and in a sense non-adaptive or *irrelevant arm behavior* patterns should be mentioned, namely the

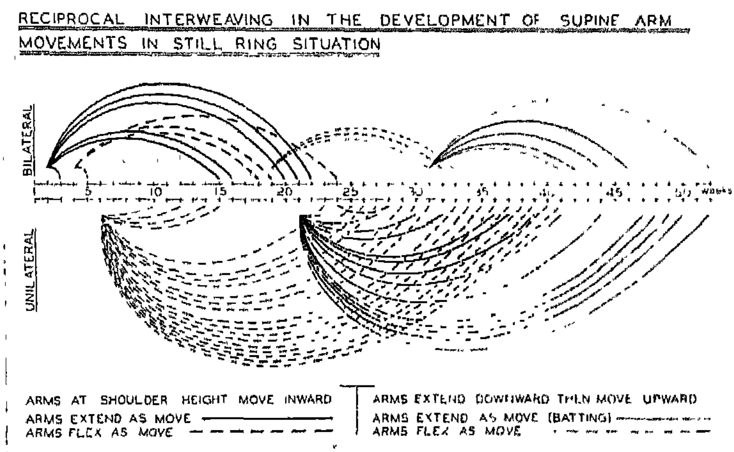


FIGURE 5

hand-to-mouth reaction including thumb-sucking, and fingering of the abdomen. These patterns occurred with sufficient frequency to justify an analysis to determine whether, when they did occur, they were observable in all three situations, namely the still rings, moving rings, and the full length non-ring situation.

The thumb-in-mouth reaction was first noted about the ninth week. From the ninth week to the 29th it tended to occur in the absence of a stimulus but disappeared when the subject's attention was attracted to the rings. From the 30th week onward, however, there were many days when the thumb-in-mouth reaction was so strong that it occurred in all situations.

Fingering the abdomen was a well defined pattern suggestive of a mannerism which may have had a developmental basis. The graph (Figure 6) shows that this idiosyncrasy was manifested in one or

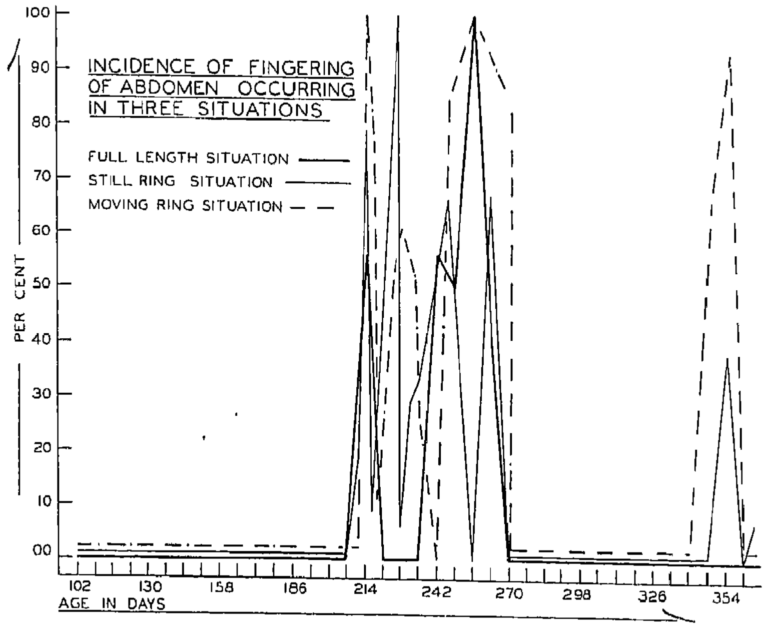


FIGURE 6

more situations at specific age periods. If the fingering were entirely fortuitous or due to skin irritation the distribution would not have been of this character.

The maturational basis of exploitational patterns is strongly suggested by the incidence of *brandishing behavior.* This brandishing behavior may be descriptively called "batting" when it strikes an object. The cinema records, however, show that well defined shadow-batting (that is, batting without an exciting stimulus) takes place at various ages from the 131st day to the 340th. Naturally enough this batting or waving pattern is also displayed in the presence of the stimulus objects (moving and still rings) on corresponding days. This correspondence is a fair example of the typical relationship between the maturational components and the exciting external stimulus in periods of rapid development. It is scarcely permissible to say that the focal stimulus produced the batting pattern.

The amount of time spent in perfect *quiescence* (exclusive of eye movements not accompanied by head or hand movements) was measured for the first day in each week, for all three situations. Earliest quiescence occurred in the moving ring situation 15 per cent as early as Day 91). The most quiescence, all days averaged, occurred in the full length situation (21 per cent as against 10 per cent in the still ring situation and 12 per cent in the moving ring situation).

On any one day there was a tendency toward a high percentage of quiescence or a marked degree of activity in all three situations.

3. *The Tonic-Neck Reflex*

The well defined asymmetric attitude so characteristic of the waking, supine infant in the first 12 weeks of life is equivalent to the tonic-neck-reflex (*t-n-r*) described by Magnus in his classic work on *Körperstellung* (8). He demonstrated that when the head of a decerebrated rabbit was experimentally turned to an extreme right or left position the following responses occurred: (*a*) extension of the forelimb on the side toward which the head was turned; (*b*) flexion of the opposite forelimb. The reflex occurred in pure form when the labyrinths were extirpated, and it was ascribed to proprioceptive impulses arising in the neck from torsion.

It is of great significance that the young human infant assumes the *t-n-r* attitude normally and spontaneously. When this "reflex" is present in classic completeness the infant spontaneously averts his head to a preferred side, laterally extends the arm on this (faceward) side and downwardly extends the homolateral leg. The opposite arm is

flexed at shoulder or occiput; the opposite leg also is flexed. In the absence of a counteracting stimulus, the eyes tend to stare in the direction of the extended arm or to fixate upon that aim. The infant may be quiescent or more or less active in this attitude.

The *t-n-r* is in the nature of a total reaction pattern. It may be regarded as the basic postural attitude of the supine infant in the first quarter of the first year. It will be interesting to inquire how this postural attitude was affected in infant M.H. when the tricolored rings were slowly moved back and forth across the field of vision. Figure 7 provides the answer in a nutshell.

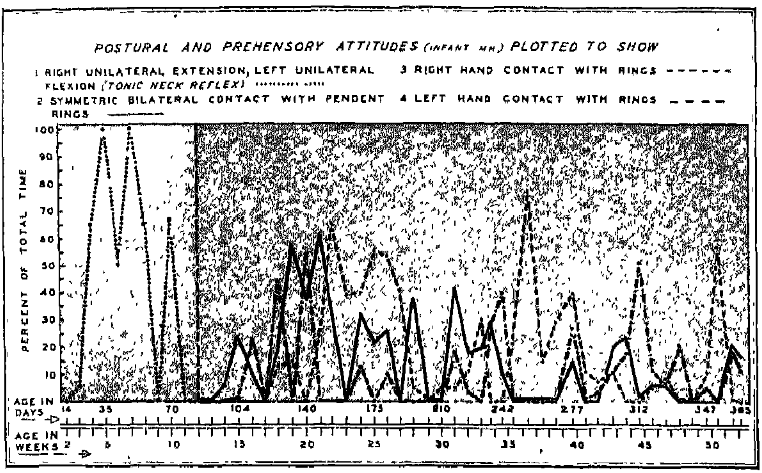


FIGURE 7

The graph is based not upon fleeting and precarious observation, but on a frame by frame analysis of the motion picture film. On Days 15, 16, 63, and 77 no *t-n-r* was observed. It was observed on every other day up to the 82nd day. As already noted, from the 17th to the 82nd day there were 834 seconds of recorded behavior; during 44 per cent of this time (372 seconds) the infant displayed the *t-n-r* pattern. Sixty-five separate *t-n-r*'s were noted in this period; all but one of these was a right *t-n-r*. Only on Day 46 did M.H. assume a left *t-n-r*, and this but momentarily.

The maturational determinants of the *t-n-r* appear to be so strong that during the first three months it is not fully overcome by an

optical stimulus which traverses the field of vision. Successive film records show that there is an increasing facility in rotating the head from an averted to a midline station, and an increasing ability to maintain a midline position; but this incrementation is gradual and appears to be due to gradual maturation rather than to specific conditioning to the moving rings or to incidental learning. Similar adherence to asymmetric postures and the gradual adoption of bilateral attitudes are evident in other aspects of M.H.'s behavior.

Analysis of the cinema records show that the head leads in the emergence of the *t-n-r* attitude. In 24 out of 38 instances the right arm followed next in the emergence of the posture. In 14 instances the left arm followed the head. Records of the dissolving *t-n-r* conversely showed that in 15 cases out of 27, it is the left arm which leads out of the *t-n-r* attitude. Five times the right arm led out, six times the head and once the trunk.

4. *Laterality*

The spatial arrangements of the experimental situation placed a premium upon symmetry of response. This very circumstance produced revealing data with respect to laterality trends. The infant, it will be recalled, was always placed in a spatially neutral environment and had unrestrained scope to show neutrality or preference for the left or right spheres of stimulus.

The use of both still and moving rings permitted a comparison of the laterality tendencies in two simple but decisively contrastive situations. The still ring situation was naturally most effective for evoking the most clearly defined postural and prehensory dispositions. These dispositions or motor attitudes are objectively measured by actual contact with the still rings or in the precontact period by the posture of eyes, head, and arms. The postural and prehensory attitudes are plotted on the accompanying graph for the total period from two weeks to 52 weeks. The graph shows alternating and reciprocal trends and the accompanying table (Table 6) summarizes the findings of a frame by frame analysis for each seventh day, and in a few instances for a few intermediate days, beginning with Day 14 and ending with Day 365.

Figure 7 graphs the per cent of recorded time as follows: (*a*) Head averted to right; right arm extended; left flexed (tonic-neck-reflex,

TABLE 6

UNILATERALITY AND BILATERALITY OF POSTURAL ATTITUDE AND PREHENSORY CONTACT (OF RINGS) PLOTTED IN PERCENTAGE OF TOTAL CINEMATICALLY RECORDED TIME (AGES: 15 DAYS—365 DAYS)

Age in days	Duration of run in seconds*		% Right unilateral extension	% Left unilateral extension
14	15		.00	.00
21	13		.06	.00
28	11		.65	.00
34	9		1.00	.00
42	9		.51	.00
49	22		1.00	.00
56	16		.65	.00
63	13		.00	.00
70	16		.67	.00
77	11		.00	.00
		% Symmetric bilateral contact	% Contact right hand	% Contact left hand
84	14	.00	.00	.00
91	10	.00	.00	.00
97	23	.06	.00	.00
104	21	.23	.00	.01
112	13	.10	.00	.23
119	15	.00	.00	.00
126	24	.20	.13	.44
133	13	.57	.15	.00
140	14	.38	.00	.54
147	13	.61	.26	.00
154	17	.32	.61	.00
161	15	.00	.39	.00
168	15	.32	.40	.13
175	14	.22	.55	.00
182	12	.26	.53	.10
189	15	.00	.41	.00
196	14	.38	.05	.00
203	12	.00	.00	.00
210	14	.00	.05	.00
217	13	.41	.05	.18
224	14	.18	.12	.03
231	12	.20	.30	.00
235	14	.29	.00	.28
242	14	.10	.00	.40
247	18	.00	.23	.00
256	15	.00	.77	.00
263	10	.00	.15	.00
270	12	.00	.29	.00
277	14	.15	40	.27
284	18	.00	.11	.01
291	11	.00	.07	.03
298	13	.20	.11	.11
305	15	.24	.00	.18
312	14	.02	.00	.51

TABLE 6 (*Continued*)

Age in days	Duration of run in seconds	% Symmetric bilateral contact	% Contact right hand	% Contact left hand
319	17	.06	.05	.12
326	22	.06	.08	.07
333	14	.00	.00	.21
340	16	.00	.00	.00
347	21	.00	.11	.05
354	18	.00	.57	.00
361	18	.21	.01	.19
365	21	.17	.00	.12

*Length of time each day is recorded in seconds but was computed in 1/16 of a second.

unilateral attitude), fourteenth to eighty-sixth day. (*b*) Symmetric, bilateral contact of both hands with rings. (*c*) Unilateral (right handed contact). (*d*) Unilateral (left handed contact).

The graph shows marked preponderance of asymmetric attitudes during the first 12 weeks of life; at 20 weeks bilateral attitudes (resulting in bimanual contact with the rings) are dominant; thereafter, right unilateral, left unilateral, and bimanual approach recur in a more or less periodic manner, right handedness becoming increasingly pronounced.

A similar plotting of the contact in the moving ring situation conceals the unilateral and bilateral trends which are so clearly evident in Figure 7. This suggests that all studies of laterality must take into account the complexity of the stimulus factors.

Infant M. H. showed a strong rightward trend as early as the third week. The thumb-sucking trend, however, favored the left hand rather than the right hand. This is in itself probably an indication of a strong dextral trend. The tendency of the left arm to flex in the *t-n-r* attitude brought the left thumb near the mouth and the prehensory drive favored the use of the right arm and hand.

Cinema records of developmental examinations of M.H.'s behavior in normative test situations were available. These records were analyzed at monthly age levels for the percentage of time during which test objects were handled with the right hand, the left hand, and both hands. It appeared that, throughout, M.H. is mostly righthanded. Lefthandedness does not rise above 18 per cent at any one examination.

At 20 weeks and 32 weeks, however, M.H. uses both hands to-

gether more than either hand alone. This agrees with a graph of hand behavior in the still ring supine situation, when bilateral behavior exceeds unilateral behavior at these two age levels.

Lefthandedness occurs in this case to a lesser degree than in many righthanded children. The strength of her righthandedness is suggested in the *t-n-r* behavior, in which only one of 65 separate observable *t-n-r*'s was lefthanded, over a period of 65 days. This lefthanded *t-n-r* occupied only one per cent of the time on the day of its occurrence. On this same day, M.H. spent 56 per cent of the time in a right *t-n-r*. Definite righthandedness has continued to assert itself through the seventh year.

The laterality trends are so well established in M.H. that they assert themselves whether she is in the sitting posture or the supine posture. This is clearly shown in the accompanying graph (Figure 8)

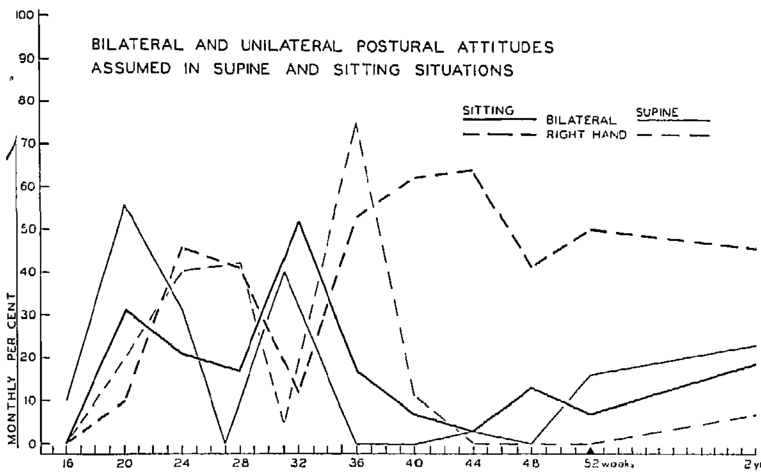


FIGURE 8

and suggests that the hand orientations are determined by true propensities rather more than by the topographic orientations and strains of the body.

This graph shows bilateral and unilateral contact in the normative sitting situations, as compared with bilateral and unilateral contact of rings when M.H. is in the supine position. It indicates a striking similarity in the trends of bilaterality and unilaterality regardless of body orientation.

Footedness is not decisively shown by the cinema records. In most of the 58 typical (weekly) postures, the legs were in symmetric or bilateral attitudes. In 14 of these cases, however, the left foot crossed over the right knee and the right leg was held in more or less tonic extension. In only one instance was this relationship reversed. If this extensor trend of the right leg is symptomatic, M.H. is right footed.

5. *Still and Moving Rings Compared as Stimuli*

Comparative inspection of Figures 2 and 3 shows that the still rings elicit more contact than the moving rings. The first instance of contact also favored the still rings, by one week. After the 247th day there was very little contact established with the moving rings although the still rings continued to elicit considerable contact.

The general trend apparent in the graphs is confirmed by the averages computed for 42 weekly intervals from 84 to 365 days. The average amount of contact for this period is 40 per cent for the still rings as opposed to 16 per cent for the moving rings. The impulses to exploitation are evidently more completely satisfied by manipulation of still rings. It is also probable that the mere ocular-motor pursuit of the moving rings offers its own satisfactions apart from manipulation.

It is significant that the moving rings did not disturb the laterality trends already noted and did not result in a greater prominence of use of the left hand. Bilateral contract drops out entirely after the 247th day. As previously noted there were a few occasions when the left hand showed priority and this priority evidently had a developmental basis because it was asserted both in the moving and still ring situation.

6. *Methods of Capture*

For the infant, the *moving ring situation* is a challenge to fundamental impulses of pursuit, appropriation and seizure. To be sure, there were days and sometimes a succession of days when the infant was so preoccupied with finger sucking and other forms of exploitation that she made no attack upon the rings. These interludes were few. It is a remarkable fact that the moving ring situation did not set up a cumulative ennui. The situation remained the same, but not the

infant. She was growing so rapidly that she had new motor patterns to utilize from day to day. Accordingly there were interesting innovations introduced into the methods of capture as she matured. They are properly called innovations rather than learnings because the child at no time adopted a proficient procedure as a conclusive method.

Two methods of capture were utilized, the one-handed and the bilateral. It was possible to catch the rings either going over (to the infant's left) or on the way back (to the infant's right). The data were carefully analyzed to determine the catches, the misses, the direction of movement on seizure, and the hands used. The methods of *bilateral* capture showed the following ontogenetic sequence between days 96 and 242:

Method 1: Misses over and back.
Method 2: Catches on the way back.
Method 3: Misses on the way over but catches on the way back.
Method 4: Catches going over.

This sequence of method is in accordance with what adult commonsense would expect, but the sequence certainly was not adopted because of the infant's commonsense. It was adopted because this was the natural growth sequence for the coördination of eye and hand postures and eye and hand movements. The sequence indicates an increasing alertness of the eyes which makes possible anticipatoriness which in turn affects the skill and the mode of capture.

Having "learned" to catch on the way back the child did not use this expedient exclusively; nor did she linger to perfect this effective expedient. Her business was not one of ring catching. Her primary business was one of growth.

Table 7 summarizes in more detail the methods of capture as they changed from day to day.

On any given day M.H. did not necessarily limit herself to bilateral approach and capture. She might also make unilateral approaches, with and without success. The predominance of bilateral over unilateral manœuvers apparently was not fortuitous but was associated with the bilaterality trends, some of which have already been discussed. A tabular summary of the bilateral and unilateral hand behaviors resorted to in the moving ring situation follows (Table 8). It will be noted that there is a reciprocal kind of alternation from

TABLE 7

BILATERAL GRASP BEHAVIOR IN RESPONSE TO MOVING RINGS

Days	Behavior
96-111	Both hands miss either over and back or just coming back. (Except both catch, on way back, days 106, 107, 112)
126-130	Both hands miss, over and back.
133,134	Both catch, coming back.
140,142	Both miss going over; catch coming back.
143	Catch going over.
145,146	Miss, over and back.
148	Catch going back.
155	Miss again, over and back.
176-187	Catch, going over.
224-242	Catch, going over.

TABLE 8

BILATERAL AND UNILATERAL HAND BEHAVIORS IN RESPONSE TO THE MOVING RING SITUATION

Days	Behavior
106-112	Bilateral. Misses on way back.
126-130	Bilateral. Misses over and back. Left hand catches going over; right, coming back.
133-155	Much bilateral activity. Most often misses going over; catches coming back.
154-179	Mostly left catches going over; right, coming back though on different days.
176-196	Bilateral catches going over. Right catches going over or coming back.
198-223	Either right or left catches, usually going over.
224-242	Bilateral catches going over. Either left or right catches going over; right, on way back.
247-263	Not much contact any longer. Left misses going over. Right misses coming back.
270-361	Left thumb in mouth; right hand at side. No contact of ring.

bimanual to unimanual activity. Especially noteworthy is the resurgence of bilateral approach between Days 224 and 242. This bilateral trend coincides with the bilateral trends which our normative investigation had found to be characteristic of this age period.

Methods of capture of the still rings have already been discussed in detail in the section on Laterality. Since the stimulus object remains stationary, the response is simpler than in the moving ring situation. Any effort at grasp is seldom unsuccessful. The bilateral-unilateral trends approximate but do not coincide in the two situations.

TABLE 9
HANDEDNESS OF CONTACT OF THE STILL RINGS

Day	Handedness of Contact
97-104	Bilateral
112-126	Left handed
133-147	Bilateral
154-189	Right handed
196-224	Bilateral
231-291	Right handed
298-305	Bilateral
312-340	Left handed
347-354	Right handed
361-365	Bilateral

D. LEG BEHAVIOR

1. *Leg Postures*

To superficial observation, leg behavior in the supine child appears to be utterly aimless and unpredictable. A systematic examination of the daily and weekly cinema records, however, reveals the presence of unquestionable developmental trends which influence the frequency and the form of varied leg postures. The reader should be reminded that the infant was under no restraint in the moving and still ring situations and therefore was at liberty to assume an unlimited variety of postures if they were at her disposal as part of her repertoire.

Daily habituation to the cubicle may have somewhat subdued and even restricted the amount of activity but it did not obscure what proved to be definite progressions in developmental patterning. A rather exacting method was used to test the existence of developmental trends. The daily records for a single week were reviewed. From these records the two consecutive records which were adjudgd most typical were chosen as representative of a given week. This was done for the whole series of 50 weeks. In six additional instances the developmental changes were sufficiently great to require two predominant weekly specimens similarly chosen.

The predominant posture was uniformly regarded as the most typical for the purposes of this analysis and a photo-tracing was made of three or four phases of this postural attitude or movement. The entire series of some 200 tracings was then reviewed to determine whether they fell into natural groupings. Somewhat to our surprise it was possible to establish 10 groups which are summarized in Table 10.

TABLE 10

Typical Leg Postures, Still and Moving Rings

Stage	Days	Weeks	Behavior
1	23-63	3-9	Both flexed
2	74-85	10-12	Both extended
3	91-148	13-21	One flexed; one extended
4	154-182	22-26	Both extended
5	187-197	27-29	One flexed; one extended
6	224-235	32-33	Both flexed
7	242-263	34-37	Both extended
8	270-305	38-43	One flexed; one extended
9	312-326	44-46	Both extended
10	333-365	47-52	One flexed; one extended

It is not suggested that there are only 10 distinguishable stages in the maturation of the supine leg postural activity. These 10 stages, however, constitute a fair epitome of the frequencies which occurred from the 17th day to the 365th day. It is significant that these 10 intervals reflect recurrent alternation of flexion and extension, unilateral and bilateral postures, characteristic of the process of reciprocal interweaving.

On the basis of the tracings and film inspection described above, it was possible to determine whether the leg activity for any given day showed a predominance of extensor, flexor, or intermediate activity. These determinations were made serially and the periods of dominance were graphed in the accompanying bar diagram (Figure 9).

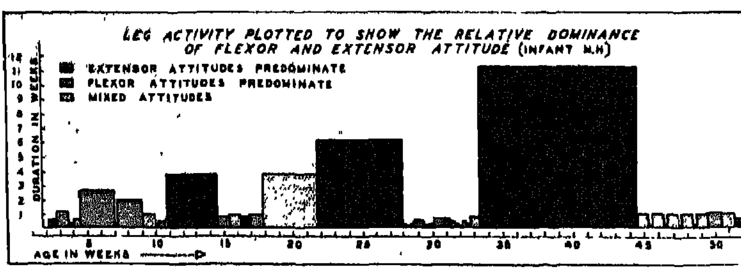


FIGURE 9

Seen in the perspective of a full year, it will be noted that with respect to leg posturing there is a definite increase in the relative proportion of extensor dominance up to the age of 45 weeks. Between

45 and 52 weeks the flexor and extensor and mixed tendencies are relatively equal. This can be construed as a developmental prefigurement or forward reference to ultimate upright walking. Needless to say, however, the upright walking does not occur because of a mere access of strength in the extensors, but because of a more complete reciprocal inteiconnection between flexors and extensors.

Figure 10 graphs the prevailing leg postures for the period from

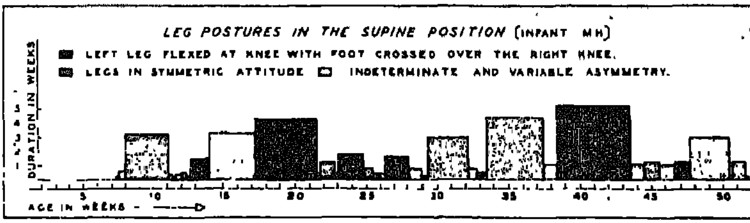


FIGURE 10

the 7th week to the 52nd week with regard to symmetry and asymmetry of posture. This period was distinguished by a frequently recurring asymmetric pattern in which the left leg, flexed at the knee, brought the left foot over the right knee. This reaction was first observed during the 7th week and repeated itself with such consistency at subsequent age intervals that it could not be set down as a casual mannerism. During the 8th, 9th, and 10th weeks it was succeeded by an equally definite symmetric attitude of the legs. We find throughout the remainder of the year, as the graph indicates, that there were rather well defined periods of alternation between symmetry and asymmetry of the leg attitudes.

E. Is Maturation Gradual or Saltatory?

We can seek an answer to this question by an empirical pragmatic use of the criterion of typicalness. Arbitrarily we selected the first day of the week, inspected the cinema record of the behavior for that day and then compared the behavior noted with the behaviors for the six next succeeding days of the same week. In a surprising number of cases it was found that this arbitrarily chosen first day of the week was fairly representative of the remaining six days. That is to say that within any given week marked, revolutionary or saltatory changes seldom occurred, although it was possible to discern

trends toward change. For the full length situation 21 out of the 26 first days;[2] for the still ring situation 20 out of 22; and in the moving ring situation 24 out of the 32 days are adjudged as typical of the week's behavior. If maturation had proceeded on an irregular saltatory basis, the test of typicalness would not have yielded such dramatic results.

Typicalness from a genetic point of view is a relative concept. It is relative to age, maturity factors, length of period of observation, and number of observations. Even when observations are made daily there is a factor of selectivity. Only a fragment of the day is observed. Our premise is that this fragment is somewhat typical of the child's total day. When these days are arranged in continuous sequence we can appraise the growth trends of behavior for separate weeks. Since the changes are swift and extensive we do not ask whether one week is more typical than another. We must assume that there is a progressive trend from week to week. Our arbitrary typicalness test just described confirms a gradual and progressive trend.

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[2]After the 235th day records are made only once a week. Thus we do not have 52 "first days." The still ring situation did not begin till the 84th day.

REFERENCES

1. AMES, L. B. Supine leg and foot postures in the human infant in the first year of life. *J. Genet. Psychol.*, 1942, **61**, 87-107.
2. ———. The sequential patterning of prone progression in the human infant. *Genet. Psychol. Monog.*, 1937, **19**, 409-460.
3. GESELL, A., *et al.* An atlas of infant behavior: A systematic delineation of the forms and early growth of human behavior patterns. (2 vols.) New Haven: Yale Univ. Press, 1934.
4. GESELL, A. Cinemanalysis: a method of behavior study. *J. Genet. Psychol.*, 1935, **47**, 3-16.
5. ———. The tonic neck reflex in the human infant; its morphogenetic and clinical significance. *J. Pediat.*, 1938, **13**, 455-464.
6. ——— Reciprocal interweaving in the ontogenesis of human behavior. *J. Comp. Neurol.*, 1939, **70**, 161-180.
7. GESELL, A., & AMES, L. B. The ontogenetic organization of prone behavior in human infancy. *J. Genet. Psychol.*, 1940, **56**, 247-263.
8. MAGNUS, R. Körperstellung. Berlin: Springer, 1924.

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A COMPARATIVE STUDY OF THE SPONTANEOUS PLAY ACTIVITIES OF NORMAL AND MENTALLY DEFECTIVE CHILDREN*[1]

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A. INTRODUCTION

The numerous studies of children's play life reported in psychological literature have provided much valuable data on this important phase of child development. Most of these studies have been concerned with varied aspects of the play activities of normal children of preschool and primary ages.

A number of authors have presented data concerning the type of play activity characteristic of various age levels. McDowell (12) observed 20 two- and three-year-old children in a free play situation in which 32 toys were offered. These were classified in seven groups, which were, in order of popularity: (*a*) materials for construction (e.g., blocks); (*b*) materials for manipulative skill of small muscles (e.g., puzzle); (*c*) toys used in playing house; (*d*) materials for physical activities (e.g., slides); (*e*) materials for creative design (e.g., paint); (*f*) picture books; and (*g*) materials for only a small amount of physical activity (e.g., pull toys). He found no significant sex differences, but he did find a more organized, purposeful play at three years than at two.

In a study of preschool children 18 to 48 months of age Arrington (1) found that active experimentation with material resources and physical activity increased with age, within the age group studied, and daydreaming and inactivity decreased with age. Van Alstyne (15) studied 112 children two to five years of age in a free play situation. She found that with increased age constructive activity and dramatization gained ascendance over manipulative

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[1]From the Wayne County Training School at Northville, Michigan, Robert H. Haskell, M.D., Medical Superintendent. *Studies in Educational Disabilities and Mental Deficiency*, directed by Thorleif G. Hegge, Ph.D., Director of Research and Education.

activity. She also found wide individual differences in the choice of play materials and the time spent with them. An experiment by Farwell (6) more nearly approaches the age range of the present study. She observed 271 children, 89 in kindergarten, 107 in the first grade, and 79 in the second grade. Her 13 play materials, all designed for constructive play activity, were divided into the following classes: modeling, building, drawing, painting, work with cardboard, and work with paper materials. Modeling and painting were very popular with both the boys and the girls, building was popular with the boys and sewing with the girls, work with cardboard and paper was relatively unpopular with both boys and girls. Within the range of materials offered, popularity lists were similar for the three age groups.

The reported attention or interest span of a child has varied greatly from experiment to experiment and there is a wide range within a given experiment. In Hulson's (8) investigation of 10 four-year-olds the mean time was 7.4 minutes spent on the first choice, but the interest span decreased from choice to choice. The mean span reported by Bott (2) was lower than that of Hulson, but increased from 2.7 minutes for two-year-olds to 5.3 minutes for three-year-olds. Bridges (3, 4) reports a median span of 8.1 minutes at three years and 6.2 minutes at four years. Van Alstyne (15) reported an increase of attention span of approximately two minutes per age level, beginning with 6.9 minutes at two years. Herring and Koch (7) believe that the attention span is a function of the toy itself.

A study very similar in experimental situation to the present one is that carried out by Helen Thompson (14) at Yale University with five-year-old children.

> The examination . . . included a 15-minute period of free play in a room equipped with a standardized arrangement of seven simple but varied toys. The child was told that he might play with them in any way he wished. Two observers, one in the room with the child, the other behind a one-way vision screen, recorded the sequence, duration, and type of play in which the child engaged.

She reported close agreement between the records of the two observers, and found pronounced sex differences as well as wide indi-

vidual differences in the choice of play materials and length of play period.

In contrast with the above studies, the present experiment was designed not primarily as an investigation of the play of normal children, but as a comparison of the play activities of matched groups of normal and mentally defective children.

B. Experimental Method

Our subjects were three groups of 25 children each: (*a*) a mixed group of normal children (14 boys and 11 girls); (*b*) a group of mentally defective girls; and (*c*) a group of mentally defective boys. The normal group was selected from the public Elementary School at Northville, Michigan,[2] and the two mentally defective groups were selected from the population of the Wayne County Training School. The mental ages of these children ranged from 6 through 8 years, the average for the normal group being 7 years, 6 months, for the mentally defective girls 7 years, 5 months, and for the mentally defective boys 7 years 6 months. The *IQ*'s for the normal group ranged from 93 to 114, with an average of 104. The *IQ*'s for the two mentally deficient groups ranged from 60 to 75, the average for the girls being 66, for the boys 68.

The *IQ*'s for the mentally defective children were based on their most recent Binet test, which had, in all instances, been given within the year preceding this experiment. With four exceptions *IQ*'s of the normal group were based on the average of two Pintner-Cunningham *Primary Mental Tests,* one given in February, 1940, and the other in October, 1940. In the remaining four cases the October test was a Haggerty *Intelligence Examination, Delta 2.* The normal children were selected on the basis that both test scores of the child should fall between 90 and 115, and that the two scores should differ by 10 points or less. These criteria were met in all but four instances.[3] The range of chronological age for the normal

[2]The authors wish to express their appreciation for the splendid coöperation and assistance of Mr. Russell Amerman, Superintendent of Schools, of the primary teachers, and especially of Mr. Paul Carter, Principal of the Elementary School.

[3]The respective scores of these four children were 114 and 100, 92 and 104, 113 and 101, and 109 and 92. In selecting the children for this study 68 children were retested on the Pintner-Cunningham. The difference between the group averages for the first and second tests was 2.5 points, while the

children was from 5 years, 8 months, through 8 years, 10 months, the average being 7 years, 2 months. For the mentally defective children the chronological age range was 9 through 12 years, the average for the girls being 10 years, 11 months, for the boys 11 years. These groups are described in greater detail in Table 1.

TABLE 1
DESCRIPTION OF SUBJECTS

Group (Mental age range)	Number children	Average *MA*	Average *CA*	Average *IQ*
Normal (*MA* 6-0 to 6-9)	8	6-4	6-3	101
Normal (*MA* 7-2 to 7-10)	9	7-6	7-2	105
Normal (*MA* 8-2 to 8-10)	8	8-7	8-3	104
Total Normal	25	7-6	7-2	104
Men. Def. Girls (6-1 to 6-11)	8	6-7	10-0	66
Men. Def Girls (7-2 to 7-11)	9	7-6	11-5	66
Men. Def. Girls (8-0 to 8-8)	8	8-3	12-5	67
Total Men. Def. Girls	25	7-5	10-11	66
Men. Def. Boys (6-3 to 6-11)	8	6-8	9-9	68
Men. Def. Boys (7-1 to 7-11)	9	7-8	11-7	66
Men. Def. Boys (8-0 to 8-11)	8	8-4	11-9	71
Total Men. Def. Boys	25	7-6	11-0	68

The play room used with the mentally defective groups was a large room which had formerly been used as a school room. On the west side of the room were the one-way screen for the hidden observer and a chair for the observer who remained in the room with the child. The 16 play materials were arranged in a fixed order along the other three walls. Along the north wall were two tables, on the first of which were laid the sewing materials, consisting of cotton prints, needles, thread, scissors, pins, buttons, lace, and braid. Here also was the doll unit, a doll set upon the table and a bed placed beside the table. On the second table were the scrapbook materials—magazine pictures, paper, brads, paste, and scissors, and the drawing materials—paper, pencils, crayons, and scissors. In the northeast corner was a blackboard with colored chalk. Against the wall opposite the observers was a table on which were placed a 70-piece brightly colored children's jig-saw puzzle, jacks and ball, a deck of Flinch cards, and a pegboard. In the southeast corner

average difference between scores was 3.6 points, the interquartile range from 4 to 17.

were 16 dozen building blocks of various shapes and sizes, a large brightly colored ball, and a jump rope. There were two tables along the south wall. On the table farther from the observers were dishes of clay (red, green, gray, and brown) and a set of commercial molds; pink, white, and blue wooden beads and a shoe string; and a vividly illustrated picture book. A miniature game of croquet mounted on wall board was placed on the last table. The center of the room was clear.

It was discovered in trial runs with non-experimental mentally deficient children that it was necessary to provide concrete suggestions for the use of the various materials. Therefore, a sample scrapbook was presented with the scrapbook materials, a picture of a house was with the drawing materials, there was a house drawn on the blackboard, and a house was built with the blocks.

The experimental situation was almost identical for the normal group. For this group one end of the auditorium of the Northville Elementary School, partitioned from the rest of the room by curtains, was used. The play materials were arranged in the same order used with the mentally defective groups, and the observers were in the same relative places.

Only one child was brought into the play room at a time. He was accompanied from the cottage or school room by the observer, who told him that he was going to a room where there were a number of playthings and that he could play with anything there. The observer had previously become acquainted with the mentally defective subjects on the playground, and in each group the experiment was introduced by the preliminary observation of several children whose records were not included in the final data. When the play room was reached the child was shown around the room in a definite order, usually beginning with the doll and sewing table and continuing around. In two or three instances the children provided their own order. The observer talked about the materials, handled the different objects and urged the child to do so. This introductory period of approximately five minutes served to familiarize the child with the toys and with the experimental situation. When the child had seen all the materials he was led to the middle of the room and told to play with whatever he wished.

Both observers began to record when the child began his first

activity. The time, the activity, the comments of the child, and the changes of activity were recorded. After the play period had begun the observer in the room initiated no conversation. She answered questions and praised work brought to her for inspection, but gave no material aid. The period was stopped at the end of 30 minutes. In some cases the child was allowed to finish the object on which he was working.

C. Analysis of Data

The records were analyzed quantitatively and qualitatively for each group and for each mental age within each group. In addition to a study of the popularity of the various play materials and of the length of play period, the various types of play activity were analyzed and classified in the following five categories:

> *B*, is constructive activity, that is, any activity in which the child "makes something." This includes making a doll dress, making a scrapbook, drawing a picture of a house without landscaping or figures, placing the pegs in any design on the peg board, building a house with the blocks, and stringing the beads in a pattern.
>
> *A*, original constructive activity, is a special category of *B*. It describes all construction based on ideas not directly suggested by the materials themselves, if the idea is successfully followed through and the end product is of acceptable quality. It includes sewing anything other than a doll dress, drawing anything other than a house or drawing a house to which has been added landscaping and other details, building anything other than a house with blocks, molding a figure in clay without using the commercial molds, and placing the pegs in an original design. The first phrase of the definition of this category, all construction based on ideas not directly suggested by the materials themselves, provides a highly objective criterion which was followed with three exceptions, in which the product was of such poor quality as to exclude it from this category. These exceptions were: (1) an extremely poorly executed landscape drawing, (2) a crude drawing of a lined sheet of paper, (3) the writing of a few simple spelling words on the board.
>
> *C*, defines activities with both games and toys. It includes dressing the doll and playing with her, putting the puzzle together, using the commercial molds with the clay, playing croquet, playing jacks, playing with the cards, jumping rope, and playing with the ball.

D, is manipulative activity, that is, handling the materials when no real play activity results. It occurred as handling of sewing materials, random inspection of drawing and scrapbook materials, scribbling, and stringing the beads without pattern.

E, is called inspection and observation, and is applied only to periods ranging fiom thirty seconds to one minute. These are brief periods in which the child inspects the play material and then decides not to use it.

Miscellaneous includes brief play periods of less than thirty seconds, periods of going around the room inspecting several play materials, periods of merely talking to the observer about any subject other than the play materials, and any other unclassifiable periods of time.

D. Results

Results may be summarized under three headings: (*a*) choice of play materials, (*b*) length of play period, and (*c*) type of play activity. Table 2 lists all play materials in order of their popularity

TABLE 2

Play Materials in Order of Popularity

Normal children			Ment. defective girls			Ment. defective boys		
Play object	Total time	Number children	Play object	Total time	Number children	Play object	Total time	Number children
Blocks	141 min.	13	Clay	95 min.	16	Croquet	89 min.	16
Drawing	109	9	Scrapbk	175	12	Scrapbk	108	11
Puzzle	98	10	Croquet	78	16	Pegboard	83	12
Chalk	75	11	Sewing	51	11	Clay	71	14
Clay	60	14	Pegboard	50	10	Puzzle	97	10
Beads	63	6	Drawing	62	6	Jacks	29	10
Scrapbk	63	4	Chalk	29	7	Ball	32	9
Sewing	53	5	Jacks	42	5	Sewing	36	6
Pegboard	33	7	Puzzle	24	6	Rope	33	7
Croquet	13	4	Cards	35	3	Beads	38	5
Ball	8	4	Doll	16	5	Drawing	33	5
Book	6	4	Beads	13	5	Book	21	8
Rope	4	3	Blocks	21	3	Doll	27	6
Doll	3	1	Rope	17	3	Cards	19	3
Jacks	1	1	Book	13	4	Blocks	3	3
Cards	½	1	Ball	7	4	Chalk	2	2

from most popular to least popular for each group. Popularity of a given play material may be measured either in terms of time, that is, total number of minutes during which it is in use, or in terms of children, that is, number of different children who played with it.

In this table the ordinal position is the average of the positions as determined by these two criteria.

Of greatest interest are the play materials at the beginning and at the end of the three lists. Among the five materials most popular with the normals three (blocks, drawing materials, chalk) are used entirely in constructive activity and a fourth, the clay, may be used either to construct figures or merely to mold pictures with the commercial molds provided. Among the most popular materials for the mentally defective girls two in five (sewing materials, scrapbook materials) are used for constructive activity. No child in this group used the clay constructively. The mentally defective boys chose, among their five favorite play materials, only one which is used exclusively in "making something," the scrapbook materials The clay was used for construction in this group. There is some question whether the scrapbook materials are constructive in the same sense as are the blocks, drawing materials, chalk, clay, and sewing materials. They are, of course, used in making something, but it is doubtful whether pictures to be cut and pasted are raw materials in the same sense as clay, blocks, and chalk, with which the child must be able to visualize and carry through an idea, be it borrowed or original.

In their five most popular play materials the normal children included four which imply constructive activity, the mentally defective girls two or one as the scrapbook materials are included or excluded, and the mentally defective boys the same number as the girls. A composite list for the mentally defective boys and girls includes, in the order of their popularity, the croquet game, scrapbook materials, clay, pegboard, and puzzle.

The lists of least popular materials illustrate the complement of the greater preference of normal children for constructive play materials, that is, an almost complete lack of interest in toys which imply a more or less mechanical, unimaginative, highly specific type of play activity. In these lists four of the five materials of the normals (book, rope, jacks, cards) are of this type; four of the five for the mentally defective girls (beads, rope, book, ball); and two of the five for the mentally defective boys (book, cards). Although these lists themselves exhibit several points of similarity, the actual amount of time spent and the number of children using the

materials was markedly lower for the normal group. It should also be noted that they include, for the normals, no constructive play material, for the feebleminded girls one (blocks), and for the feebleminded boys two (blocks, chalk). The five least popular materials in the composite list for mentally defective boys and girls are book, rope, cards, chalk, blocks.

This difference in favorite kinds of play materials is strikingly illustrated in three instances. The blocks, which require highly constructive play, appear in first place on the list for normals, in thirteenth place on the mentally defective girls' list, and in fifteenth place on the mentally defective boys' list. The jacks, on the other hand, appear fifteenth for the normals, eighth for the mentally defective girls, and sixth for the mentally defective boys. The miniature croquet game was tenth in popularity among the normals, third among the mentally defective girls, and first among the mentally defective boys. These three toys appear in sixteenth, seventh, and first place respectively on the composite list.

Sex differences in the choice of play materials were minimal. The lists of five most popular choices for the mentally defective boys and girls show four identical choices (clay, scrapbook materials, croquet game, pegboard) with sewing the fifth for the girls and the puzzle for the boys. The lists of least popular articles for these two groups overlap in two instances (picture book, blocks); the other three materials are, for the girls, beads, rope, and ball, for the boys, doll, cards, and chalk. Although the number of boys, 14, and girls, 11, in the normal group is small and the data have therefore been presented as a unit, a comparison similar to the above is interesting. The most popular materials for the normal girls and boys overlap in three instances (drawing, chalk, clay) with the girls choosing beads and sewing rather than blocks and the puzzle to complete their list. The least popular choices were in four instances the same (doll, book, cards, jacks); the girls were comparatively uninterested in the croquet and the boys in the doll.

All data were analyzed according to mental age groups, but since these groups were small (8 or 9 children) and no definite trends were apparent, they have been omitted from this report.

The data on length of play period show much less definite trends than the data on choice of play articles. One play period is defined

as the total time spent with a given play material before a change of activity or material occurs. Brief interruptions of less than 30 seconds were not considered a change of activity, and similar brief periods of play with one material in the course of a change of activity were not considered as play periods, but were placed in the miscellaneous column.

The average length of play period for the normal children was 6.9 minutes, standard deviation 7.6 minutes, for the mentally defective girls 5.8±5.6 minutes, and for the mentally defective boys 5.3±6.1 minutes. The single periods of the respective groups ranged from 30 seconds to 30 minutes, from 30 seconds to 28 minutes, 45 seconds, and from 30 seconds to 27 minutes, 9 seconds. The critical ratio of the difference between average length of play period for the normals and the mentally defective girls is 1.3, between the normals and the mentally defective boys 1.7, and between the two mentally defective groups 0.6. Although these critical ratios are not significant, several facts indicate a slight tendency of the normal children to be more stable in their play behavior. The average play period is slightly longer, as indicated above. The normal group of 25 children had a total of 107 play periods, the feebleminded girls 131, and the feebleminded boys 138. Average number of play periods was, respectively, 4.3, 5.2, and 5.5. The tendency to stability is also apparent in the extreme intervals of the distribution of length of period. In the interval 30 seconds to 3 minutes fell 50 periods of the normals, 64 of the mentally defective girls, and 73 of the mentally defective boys. In the interval 27 minutes to 30 minutes fell five periods for the normals, and one each for the mentally defective girls and boys.

Table 3 presents statistical data on the analysis of play activity in terms of the categories defined earlier. Columns 1, 2, and 3 indicate the total amounts of time spent by the different groups in each type of activity; these are translated into percentages of total play time (excluding miscellaneous) in Columns 4, 5, and 6; and the critical ratios of the differences of these percentage values appear in Columns 7, 8, and 9.

The critical ratios show that the normal children spent a statistically significantly greater percentage of time on constructive activity in general (*B*) than did either of the mentally defective groups, and

TABLE 3
ANALYSIS OF TYPES OF PLAY ACTIVITY

Category	Total time in minutes: Normal children	Ment. defective Girls	Ment. defective Boys	Per cent of time: Normal	Girls	Boys	Critical ratio: *N*vs*G*	*N*vs*B*	*B*vs*G*
A	183	42	51	25%	6%	7%	4.1	3.8	0.3
*B**	498	341	286	68	47	40	3.3	4.6	1.2
C	182	308	393	25	42	54	2.8	4.9	2.0
D	47	74	37	7	10	5	1.0	0.4	1.5
E	5	7	7	1	1	1	—	—	—

*The category *B* here includes all constructive activity, whether or not the project is further scored *A*, that is, the total of *B* plus *A* as the two are described in the text.

also in the higher type here called original constructive activity (*A*). These conclusions express, even more strikingly than the data concerning popularity of play materials, the decidedly greater preference of the normal children, in a spontaneous play situation, for activity in which they were creating something, as opposed to activity in which they were following a set pattern prescribed by the materials.

The mentally defective groups spent a significantly greater percentage of their time playing with games and toys (*C*). As would be expected from the chronological and mental age groups studied, the amount of time spent in manipulative activity (*D*) is small in every instance. The time falling under observation and inspection (*E*) is insignificant for all groups.

Data on the number of children engaging in each type of play activity show the same trends as the data on the percentage of total time. Fourteen of the 25 normal children, four of the feebleminded girls, and five of the feebleminded boys did original constructive work (*A*); 23 normals, 19 mentally defective girls, and 20 mentally defective boys showed constructive activity (*B*); 19 normals, 21 mentally defective girls, and 23 mentally defective boys played with the games and toys.

E. DISCUSSION

The authors are fully aware that the unanswered questions concerning the play situation here presented are many. The effect of the presence of an adult in the play room cannot be stated. Observation of the changes in play behavior when two children are allowed

to play together would provide an interesting follow-up study. The effects of the institutional environment of the mental defectives as compared with the home environment of the normal children remain unmeasured. This difference in environment is accompanied by differences in socio-economic status, most of the institution children having come from the lower socio-economic class, the normals from the middle class.

Perhaps most important are questions concerning the play materials. The wide differences in chronological age created a problem in the choice of materials suitable for all ages involved. That this problem was met fairly satisfactorily is evidenced by the fact that only two of the 75 children asked to leave the play room before the period was ended. An obvious question centers around the relative familiarity of the different groups with the various play materials. This question cannot be answered positively, but the use of the blocks provides an interesting commentary. The blocks were identical with a set used and reported popular in the cottage of the mentally defective boys; blocks as a plaything were relatively unfamiliar to the mentally defective girls; the experiences of the normal children with building blocks were varied. Yet they were the outstanding choice of the normal children, and were quite unpopular with both groups of mental defectives.

The greater superiority of the normals in terms of spontaneous creative activity seems to be clearly demonstrated by the data. The implications of this fact are several. Theoretically, it implies that mental defectives and normals of the same mental age, that is, of the same quantitative developmental level, react differently in the face of a situation which allows the choice of an exercise of ingenuity or a stereotyped response to familiar objects.

Educationally, it would seem to emphasize the need for specificity in the training of feebleminded children, that is, a program in which the child is trained in the specific skills and attitudes which his vocational and social status will demand, rather than a generalized program in which he himself is responsible for the application and transfer of his knowledge. This does not, of course, diminish the importance of a broad program of activities in meeting problems of recreation and adjustment.

F. Summary and Conclusions

The spontaneous play activities of three groups of 25 children have been observed and analyzed. Two of these groups were mental defectives, the girls having an average *IQ* of 66 and the boys of 68; the average *IQ* of the normal group was 104. The children were brought individually into a room in which a variety of play materials were displayed, and allowed to play for 30 minutes. The results support the following conclusions:

1. The normal children showed a markedly greater preference for play materials which lead to constructive activity than did either group of mentally defective children, and a somewhat greater avoidance of games and toys which lead to more or less definitely prescribed play activities.

2. The normal children showed a slight tendency toward greater stability in the duration of their interest in each play material chosen.

3. The normal children spent a statistically significantly greater proportion of their time in constructive activity and a significantly smaller percentage in activity with games and toys than did the mentally defective children.

4. No marked sex differences were apparent, either in choice of play materials or type of play activity, with the exception that the girls of both groups showed more interest in the doll and the sewing materials than did the boys. The differences between either group of mental defectives and the normals were much greater than the differences between the two groups of mental defectives.

References

1. Arrington, R. E. Interrelations in the behavior of young children. *Child Devel. Monog.*, 1932, No. 8.

2. Bott, H. Observation of play activities in a nursery school. (In) Bott, E. A., Blatz, W. E., Chant, N., and Bott, H. Observation and training of the fundamental habits in young children. *Genet. Psychol. Monog.*, 1928, **4**, 1-161.

3. Bridges, K. M. B. Occupational interests of three-year-old children. *J. Genet. Psychol.*, 1927, **34**, 415-423.

4. ————. The occupational interests and attention of four-year-old children. *J. Genet. Psychol.*, 1929, **36**, 551-570.

5. Cockrell, D. L. A study of the play of children of pre-school age by an unobserved observer. *Genet. Psychol. Monog.*, 1935, **17**, 377-469.

6. FARWELL, L. Reactions of kindergarten, first-, and second-grade children to constructive play materials. *Genet. Psychol. Monog.*, 1930, **8**. 431-562.

7. HERRING, A., & KOCH, H. L. A study of some factors influencing the interest span of pre-school children. *J. Genet. Psychol.*, 1930, **38**, 249-279.

8. HULSON, E. L. An analysis of free play of ten four-year-old children through consecutive observations. *J. Juv. Res.*, 1930, **14**, 188-208.

9. HURLOCK, E. B. Experimental investigations of childhood play. *Psychol. Bull.*, 1934, **31**, 47-66.

10. LEHMAN, H. C., & WITTY, P. A. Periodicity and growth. *J. Appl. Psychol.*, 1927, **11**, 106-116.

11. ———. A study of play in relation to intelligence. *J. Appl. Psychol.*, 1928, **12**, 369-397.

12. McDOWELL, M. S. Frequency of choice of play materials by pre-school children. *Child Devel.*, 1937, **8**, 305-310.

13. STODDARD, G. D., & WELLMAN, BETH L. Child Psychology. New York: Macmillan, 1934. Pp. xii+419.

14. THOMPSON, H. Spontaneous play activities of five-year-old children. *Psychol. Bull.*, 1936, **33**, 751.

15. VAN ALSTYNE, D. Play behavior and choice of play materials of Pre-School Children. Chicago: Univ. Chicago Press, 1932. Pp. xii+104.

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A COMPARISON OF THE REVISED STANFORD-BINET, FORM L, WITH THE KUHLMANN TESTS OF MENTAL DEVELOPMENT*

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In examining suspected mental defectives, many city and state clinics are extensively employing both the *Revised Stanford-Binet, Form L* (8) and the Kuhlmann *Tests of Mental Development* (6). On the other hand, some organizations prefer to use only one of these instruments. In any case it is important to realize that final scores on either of these tests very often carry great weight in a diagnosis of feeblemindedness. Because of this, and because many research departments use only the Kuhlmann or the Revised Stanford-Binet to conduct surveys of the number of mentally retarded children in a county or state (1), it is necessary to know the relationships between the two instruments. In other words, are the Kuhlmann Tests related to Form *L* of the Revised Stanford as well as Forms *L* and *M* are related to each other. How probable is it that a given group of subnormal children will make a higher mean score on one test than on the other? Can scores on both examinations be combined or interchanged? To answer questions of this nature, the following study was conducted at the Minnesota School and Colony during 1938-39.

In designing this experiment the writer proposed the hypothesis that, within the specified population, there were no significant differences between the mean *IQ*'s and *MA*'s and between the standard deviations of the *IQ*'s and *MA*'s of these two tests; also, that *IQ*'s obtained on either test could readily be interchanged or combined.

The writer first eliminated from the population between the ages of 16-0 and 17-5 all who had scored below 50 on the 1932 edition

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of the Kuhlmann-Binet (5); and next, all who had serious speech, physical, or sensory handicaps or were classified as "clinical types" (4, p. 202). The experimenter then administered the Gray *Oral Reading Paragraphs Test* (3) to the remaining group of 61 cases. Following this, 10 cases who failed to score above the middle of the third grade on the Gray Test were excluded from the study. Since both Terman (8, p. 255) and Kuhlmann (6, p. 165) specify or intimate that subjects must have at least a third grade reading ability in order to handle the printed vocabulary, phrase, and sentence material in their tests, the writer regarded all who failed to reach this level on the oral reading test as retarded readers.

The main experimental group was thus composed of 25 males and 26 females. Form *L* of the *Revised Stanford-Binet* and 33 of the Kuhlmann *Tests of Mental Development* were administered to these subjects by the writer while 18 of the Kuhlmann tests were administered by a regular psychometrist of the State Bureau of Research. Each case was examined until he failed all sub-tests at three successive levels on the Stanford and until he completed the entire examination, up through test No. 89, on the Kuhlmann. In doing this, the factor of fatigue was carefully controlled. The Kuhlmann was given before the Revised Stanford to 23 cases and the Revised Stanford before the Kuhlmann to 28 cases. The time between the administration of the two tests ranged from 5 to 349 days with the median at 19 days. Prior to this, although no subject had ever been examined with the Revised Stanford, all had been examined with a preliminary edition of the Kuhlmann *Tests of Mental Development*. However, the time between the administration of the preliminary edition and the Kuhlmann tests reported in this paper ranged between 11 and 74 months with the mean at 41.8 months.

Comparison of the Tests in Terms of Mean Scores

From chronological age 13-2 to 16-0, Kuhlmann and Terman use different methods of computing the *IQ*. Because of this, a comparison of the *IQ*'s between these ages becomes a questionable procedure. Should one compare the Revised Stanford-Binet *IQ*'s obtained by use of the graduated tables (8, p. 31) with the Kuhlmann *IQ*'s obtained by using the exact *CA*, in months, as a divisor; or should one rescore the Stanford *IQ*'s according to the Kuhlmann

tables before making this comparison? In this paper the writer has studied, first, the relationship between Kuhlmann *IQ*'s (*K* in Table 1) and Stanford *IQ*'s computed according to each author's directions. Second, Kuhlmann *IQ*'s have been compared with Stanford *IQ*'s (*S*, in Table 1) computed according to the Kuhlmann tables (6, 232 ff.).

In Table 1 the differences between the means of the *IQ*'s and

TABLE 1

DATA REGARDING 51 SUBJECTS, BETWEEN THE *CA*'S 16-0 AND 17-5, WHO WERE EXAMINED WITH THE *Revised Stanford-Binet, Form L* (*S*) AND THE KUHLMANN *Tests of Mental Development* (*K*)

Data	Test	Ranges	Means	M_S-M_K	$t_{M_S-M_K}$[2]	Sigma	F	Pearson r	t_r[3]
	S[1]	46-86	66.98			9.14			
IQ's				6.88	7.90		1.57	.714	7.14
	K	46-73	60.10		$P<$ 01	7.29	$P>.05$		$P<.01$
	S_r[1]	43-80	63.20			8.42		.738	7.65
IQ's				3.10	3.65		1.31		
	K	46-73	60.10		$P<.01$	7.29	$P>.05$		$P<.01$
		6-10							
	S	to	120.43		3.34	16.52	1.36		
		12-10							
MA's[4]				5.41				.714	7.14
(in		7-4			$P<.01$		$P>.05$		
mos.)	K	to	115.02			14.16			$P<.01$
		11-8							

[1] S means that the Revised Stanford-Binet *IQ*'s have been calculated according to the Terman-Merrill tables; while S_r means that the Revised Stanford-Binet *IQ*'s have been calculated according to the Kuhlmann tables.

[2] This refers to the Fisher t test of significance of the difference between means, when variates are paired (2, p. 41-42).

[3] This refers to the Fisher t test of the significance of the coefficient of correlation (2, p. 73).

[4] Since the interval between the two testings ranged from 5 to 349 days, a constant *IQ* was assumed and the mental ages were adjusted down to the *CA* of the earlier test.

mental ages are in the direction of the Revised Stanford; and in terms of the Fisher t test, when variates are paired, are significant at the 1 per cent level. Even when the Terman *IQ*'s are calculated according to the Kuhlmann tables, they still maintain a significant difference over the Kuhlmann *IQ*'s.

These significant differences are rendered secure by the fact that

the basic assumptions for the *t* test have been fulfilled. First, the writer tested all members of a specified age group at an institution for mental defectives. Second, conditions of testing were rigidly controlled; and third, according to the *F* values in Table 1, differences in the *IQ* and *MA* variability of both tests are insignificant.

Interchangeability of Intelligence Quotients

The fact that significant differences do exist between the mean *IQ*'s and *MA*'s on the Revised Stanford and Kuhlmann is in itself a reliable indication that *IQ*'s within the specified ranges may neither be combined nor interchanged. The writer, however, has made two further analyses of the data in order to note the magnitude of the differences.

In Table 2 the differences between the *IQ*'s of the two tests have

TABLE 2

Number (*N*) and Per Cent (%) of 51 Feebleminded Subjects (*CA*'s: 16-0 to 17-5) Who Differed in the Direction of the Revised Stanford, or the Kuhlmann by More Than the Stated Number of *IQ* Points

Type of comparison		*IQ* points of difference between the two tests ±3	±5	±6	±7	±8	±9	±10
S and *K*	*N*[1]	37	29	27	23	22	18	16
	%	72.5	56.9	52.9	45.1	43.1	35.3	31.4
S_r and *K*[3]	*N*[2]	34	18	18	16	14	10	6
	%	66.7	35.3	35.3	31.4	27.5	19.6	11.8
Terman criteria: From a comparison of *L* and *M*	%	43.8	19.6	11.9	7.0	3.8	2.0	0.9

[1]Above ±4, 33 of the 34 differences were in the direction of the Stanford by 5 to 20 *IQ* points. Only one difference was in the direction of the Kuhlmann by 9 points.

[2]Above ±5, 17 of the 18 differences were in the direction of the Stanford by 7 to 15 *IQ* points. Only one was in the direction of the Kuhlmann by 12 points.

[3]See Table 1 for an explanation of these symbols.

been compared with the differences shown by Forms *L* and *M* of the Revised Stanford-Binet. By calculating the average differences between the *IQ*'s of Forms *L* and *M*, Terman and Merrill derived a PE_{IQ} (8, p. 46). For the ranges 70 to 89 this PE_{IQ} is ±2.60. Using this value, the writer has calculated the per cent of cases

that *should exceed* ceitain plus and minus *IQ* points of differences between Forms *L* and *M*. These aie listed in the bottom column of Table 2. For example, only 0.9 per cent of the subjects who take both forms of the Revised Stanford should differ by more than ±10 *IQ* points. When these criteria are compared with the differences which exist between the *S* and *K* and the S_r and *K* *IQ*'s, the extent of divergence between the Kuhlmann and the Revised Stanford may be readily seen. Thus, above ±5 *IQ* points, most of the differences weie in the direction of the Revised Stanford and the per cent of the 51 subjects that differed by more than the listed *IQ* points of difference was in every case appreciably greater than the criteria for Forms *L* and *M*. For example, according to the PE_{IQ} for Forms *L* and *M*, only 2 per cent of all cases who take both of these forms should differ by more than ±9 *IQ* points. In contrast, 35.3 per cent of the subjects in the *S* and *K* comparison and 19.6 per per cent in the S_r and *K* comparison differed by more than ±9 *IQ* points. This is another way of observing that *IQ*'s on the Revised Stanford may not be substituted for *IQ*'s on the Kuhlmann, and *vice versa*.

From time to time constiuctors of intelligence tests have referred to specific *IQ*'s and *IQ* ranges in qualitative terms. Thus, Kuhlmann in 1932 (5, p. 22) stated "that any case of mental arrest with an intelligence of 74 or lower may under any circumstances be properly classified as feebleminded." Children who scored in the range 75 to 84 he termed borderline and those in the range 85 to 94 as dull. Although Kuhlmann does not discuss this question in his 1939 handbook, other indications point to the fact that he continues to regard the *IQ* of 74 as an upper limit for the moron group.[2] On the other hand, Merrill (7, p. 650) has recently stated that on the Revised Stanford-Binet, those falling between 80 and 89 may be considered low average; those between 70 and 79 are borderline defectives; and those with *IQ*'s below 69 are mentally defective.[3] With this in mind, Table 3 should be of gieat interest to those who are responsible for diagnosing cases of mental deficiency and to those

[2]Thus, in helping to conduct a county survey in Minnesota, his buieau of mental examinations employed the *IQ* of 74 as an upper limit for mental retardation (1, p. 230).

[3]She is, however, careful [illegible]
or none criteria of mental [illegible]

TABLE 3

DISTRIBUTION OF 51 FEEBLEMINDED SUBJECTS (C.A.'S: 16-0 TO 17-5) WITHIN SPECIFIED *IQ* RANGES OF THE REVISED STANFORD-BINET, FORM *L* (*S*) AND THE KUHLMANN TESTS OF MENTAL DEVELOPMENT (*K*)

Kuhlmann *IQ* ranges	Revised Stanford-Binet *IQ* ranges — *IQ*'s calculated according to Terman-Merrill tables (*S*)								*IQ*'s calculated according to the Kuhlmann tables (S_1)						
	*A**	*B*	*C*	*D*	*E*	*F*	*G*	Total	*A**	*B*	*C*	*D*	*E*	*F*	Total
70-74		1		4		2	1	8	1		3	1	2	1	8
65-69			1	3	2			6		1	2	3			6
60-64		2	5	3	2	1		13	2	3	4	3	1		13
46-59	12	4	4	3	1			24	15	3	5	1			24
Total Cases	12	7	10	13	5	3	1	51	18	7	14	8	3	1	51

**A*=43-59; *B*=60-64; *C*=65-69; *D*=70-74; *E*=75-79; *F*=80-84; *G*=85-89.

who conduct surveys of the mentally retarded in specific localities. If the *IQ* of 74 is taken as the upper limit for mental deficiency on the Kuhlmann and the *IQ* of 69 on the Revised Stanford, from a psychometric viewpoint, 18 cases may be termed mental defectives with respect to the Kuhlmann Tests and borderline with respect to the Revised Stanford (Columns *D* and *E* in the *S* and *K* comparison). Again, four cases (Columns *F* and *G*) may be mentally defective on the Kuhlmann and only low average on the Stanford. In terms of the S_1 and *K* comparison, 12 changes were made from the mentally defective category in the Kuhlmann to higher ranges on the Stanford (Columns *D*, *E*, and *F*). In contrast, no changes were made from the range for mental defectives on the Stanford to the borderline or dull ranges on the Kuhlmann. In other words, all who scored in the range 43 to 69 on the Stanford also scored in the range for mental defectives, 46 to 74, on the Kuhlmann.

These data along with those in Tables 1 and 2 are good evidence to show that the upper psychometric limit for mental deficiency should be placed at a lower point on the Kuhlmann scale. To give an exact answer to this problem, however, both of these scales must be administered to a large, representative group of subjects with a wide chronological age range and with wide intelligence quotient ranges at each *CA*.[4] Standard deviations and regression equations

[4]The writer has calculated regression equations for the present data. Of

could then be calculated and the two tests could be accurately related. Meanwhile psychologists must be wary of interpreting any *IQ*, whether it be a Kuhlmann, a Stanford, an Arthur, or one based on a group test, in terms of a general demarcation point for mental deficiency, such as an *IQ* of 74 or 69. In addition, it should be realized that the per cent and number of mental defectives discovered by a survey in any particular county or state depend largely upon the test which has been used and the upper limits which have been employed for the moron, imbecile, and idiot groups. Finally, the writer suggests that a psychologist would do well to administer both the Kuhlmann and the Revised Stanford before recommending that a border-line subject be committed to an institution for the feebleminded. This procedure is especially urged if the subject scores an *IQ* between 60 and 74 on the Kuhlmann tests.

Summary and Conclusions

In order to determine whether *IQ*'s on the *Revised Stanford-Binet,* Form *L* could be interchanged or combined with *IQ*'s on the Kuhlmann *Tests of Mental Development,* the writer had a regular examiner from the Minnesota Mental Examination Bureau administer these tests to 51 mental defectives. Our subjects were between the chronological ages 16-0 and 17-5, had been legally committed as feebleminded in Minnesota, and were residents of the State School and Colony. An analysis of the data showed that while differences in the *IQ* and *MA* variability of both tests were insignificant, significant differences existed between the mean *IQ*'s and *MA*'s. Even when the Stanford *IQ*'s were calculated by means of the Kuhlmann tables, significant differences were still present. To survey the magnitude of these differences, the writer constructed Table 2 and Table 3. Thus, in terms of *IQ* points of difference, the divergence of Stanford *IQ*'s from Kuhlmann *IQ*'s proved to be great when compared with the relationship between Forms *L* and *M*

these only two appear to have some value for the clinician. These are, $\overline{X}=.57\ \overline{Y}+21.9$ (*S* and *K* combination); and $\overline{X}=.64\ \overline{Y}+19.7$ (S_t and *K* comparison) where $\overline{Y}$=a given *IQ*, in whole numbers, on the Kuhlmann. The standard error of estimate for the former equation is 5.1 and for the latter is 4.9. For all other equations that were computed, the standard errors of estimate were too high for reliable prediction.

of the Revised Stanford. Finally, it was found that as many as 22 of the 51 subjects scored in the ranges for mental defectives on the Kuhlmann and in the borderline and low average ranges on the Revised Stanford (*S* and *K* comparison).

Because of the differences which have been found between the two tests, it may be said with confidence that the Kuhlmann and the Revised Stanford, Form *L*, when employed with mental defectives between the *CA*'s 16-0 and 17-5, may neither be interchanged nor combined. Second, if a subject scores an *IQ* between 60 and 74 on the Kuhlmann, the psychologist, before deciding that the individual is, from a psychometric point of view, mentally defective, should administer the Revised Stanford-Binet. Third, in conducting a survey of mental defectives in a particular locality, experimenters should name specifically the instrument that they employed. According to data in this paper, the number and per cent of mentally retarded subjects will be raised or lowered depending upon whether the Kuhlmann or Revised Stanford-Binet is used.

The next step is to develop regression equations and tables which will show accurately the exact relationship between the two tests and which will give *IQ*'s on one test which equal certain *IQ*'s on the other.

References

1. Dabelstein, D. H. From the state department, Renville County survey. *Minn. J. Educ.*, 1941, **21**, 230-231.
2. Goulden, C. H. Methods of Statistical Analysis. New York: Wiley, 1939.
3. Gray, W. S. Standardized Oral Reading Paragraphs Test. Bloomington, Ill.: Public School Publ., 1938.
4. Kreezer, G. L., & Bradway, K. P. The direct determination of the probable error of measurement of Binet mental ages. *J. Educ. Res.*, 1939, **33**, 197-214.
5. Kuhlmann, F. A Handbook of Mental Tests. Baltimore: Warwick & York, 1932.
6. ———. Tests of Mental Development. Minneapolis: Educational Test Bureau, 1939.
7. Merrill, M. A. Significance of *IQ*'s on the Revised Stanford-Binet scales. *J. Educ. Psych.*, 1938, **29**, 641-651.
8. Terman, L. M., & Merrill, M. A. Measuring Intelligence. New York: Houghton Mifflin, 1937.

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THE DIFFERENTIAL EFFECTS OF NUDITY AND CLOTHING ON MUSCULAR TONUS IN INFANCY*

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The present study was motivated by varying reports (3) of the strength of the grasping reflex in human infants. Although it is undoubtedly true that differences in gripping power between infants are due in great part to differences in native constitution, the marked variations in the strength of the reflex exhibited on different occasions by the same individual indicate the presence of factors other than native constitution which affect the condition of muscular tonus. Among these factors, according to an earlier review of the literature (3), are age, temperature, emotional excitement, waking state, and the state of hunger or satiation. Since tonus is essentially a proprioceptive reflex it may well vary with cutaneous factors, particularly in infancy. It therefore seemed profitable to investigate the differential effects of the presence and absence of clothing on tonus.

The effect of clothing upon the grasping response has received very little consideration. In fact, 6 of 13 investigators failed to state whether their subjects were nude or clothed. In the remaining seven studies the conditions under which the subjects were tested were as follows: clothed, 1; diapers and shirt, 2; diapers only, 2; entirely nude, 1. In one study it was stated that the subjects were undressed; however, the photographs indicate that the diapers were not removed. In any event the results obtained in these studies were not comparable, since the investigations varied with respect to apparatus and procedure.

A. METHOD

1. *General Procedure*

In general the procedure consisted in testing the strength of the

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gripping reflex (*a*) before undressing the infant, (*b*) after undressing him, and (*c*) after reclothing him. The subjects were divided into two groups, quiescent and activated. The subjects of the first group were kept as quiet as conditions permitted. The instructions were to handle each infant very carefully, to refrain from talking, and to avoid looking directly at his face. Despite these efforts to reduce disturbances to a minimum, the probability that carrying, undressing, and reclothing the subject may have influenced the results made it advisable to repeat the experiment on a second group of subjects who were kept physically active throughout by brisk handling, smiling, and playful talking.

2. *Specific Procedures*

The infant of the quiescent group was carefully lifted from his crib by a nurse, carried in a horizontal position, and placed gently on a blanket-covered table at one end of the room where there was no draft. Both hands of the infant were then dried with a soft cloth and powdered, after which the nurse joined the experimenter and his assistant at a point well out of the infant's range of vision. After the infant had been left alone for two minutes, the experimenter and assistant approached the infant, tested his gripping strength, and then withdrew. The nurse now carefully undressed the infant without removing the clothes from beneath him, and then left him alone for two minutes before the second gripping test was given. Finally he was carefully reclothed, left to himself for two minutes, and tested for the third time.

In the second procedure the nurse, experimenter, and assistant remained close by the infant. The nurse throughout smiled and talked animatedly to the infant. She approached the crib, lifted the infant to a vertical position, and carried him to the table where he was placed supinely on the blanket. She then briskly dried and powdered the infant's hand, after which she took hold of his wrists and playfully manipulated his arms for two minutes. The gripping test was now given and the infant was undressed. After the nurse had manipulated the arms for two minutes, he was again tested. He was then reclothed and, after another two minutes of playful manipulation, tested for the third time.

Undressing and dressing caused little disturbance. The clothing

consisted of a diaper, full-length loose stockings, undershirt, and loose-sleeved dress reaching to the feet. The undershirt and dress were equipped with buttons down the front. In undressing, the clothes were not removed from beneath the infant. The dress and undershirt were unbottoned and spread out about him. The diapers were unpinned and similarly spread out, and the stockings pulled off. If the test caused a change in location, the infant was immediately restored to his original position so as not to interfere with the act of dressing.

Many infants cried during the course of the experiment. The records of those who cried during the 2-minute rest periods were discarded, whereas the records of infants who cried only momentarily during gripping were used. Infants whose diapers were damp were given dry diapers and left alone for at least 15 minutes before being tested.

The experiment was conducted in the nursery of the maternity hospital at the State Farm for Women at Niantic, Connecticut. The time selected for the experiment was 11 to 12:30 o'clock after the infant had awakened from an hour or more of sleep following the morning feeding. The temperature of the room on different days varied from 80° to 86° F. The distance from the crib to the table varied in individual cases from 9 to 15 feet.

The apparatus for testing the strength of the grip was a spring balance scale suspending a small stirrup with a grasping rod of wood (3). The scale read to 25 lbs. in quarter-pound dimensions. The rod was 10 cm. in length and 1 cm. in diameter. A rider on the scale operated with the pointer and registered the maximum pull after the spring was released. The left hand only was tested and only one trial was made in each situation. The experimenter placed the rod against the palm and then drew the hand upward to full extension. The proximal interphalangeal joints of the three longest fingers were directly above the rod with the thumb opposed. The stirrup was then pulled steadily upward until the grip was broken or the infant's body was fully suspended. Infants who succeeded in supporting the full body weight were lowered as soon as it was evident that the feet were clear of the table.

B. Subjects

Two hundred and thirty-four infants, viz., 121 boys and 113 girls, were tried on different days in both parts of the experiment. Of the total number of boys, 37 met the conditions of quiescence and 32 fulfilled the conditions of activation. Similarly 46 of the 113 girls were accepted as quiescent subjects and 36 as activated subjects. Inasmuch as 18 boys and 23 girls passed the requirements of both procedures, the total number of infants who served as subjects in the experiment was 110, of whom 51 were boys and 59 were girls. Thus there were more infants in the quiescent than in the activated group, and more girls than boys in each case.

In each group the boys were somewhat older and larger than were the girls. The mean age of the quiescent subjects wes 9.7 weeks (boys 10.5 weeks, girls 9.1 weeks). The mean age of the activated subjects was 12.7 weeks (boys 14.2 weeks, girls 11.3 weeks). The age range was the same for both groups, viz., 1 to 22 weeks. The mean weight of the subjects was 9.8 lbs. (boys 10.2 lbs., girls 9.5 lbs.) for the quiescent group, and 10.6 lbs. (boys 11.3 lbs., girls 10.1 lbs.) for the activated group. The weight range was 5.3 to 14.7 lbs. for the former group and 6.9 to 14.7 for the latter group.

C. Results

Table 1 shows the mean and median measures, in pounds and in per cent of body weight supported, of the strength of the gripping response for both the quiescent and the activated groups. The measures for each sex are also given.

According to the data the response was considerably stronger in the nude situation than in either the clothed or reclothed situations for both boys and girls of both groups. The strongest response by the boys occurred in the quiescent nude situation; the strongest response by the girls occurred in the activated nude situation. Although gripping power was in general somewhat greater for the activated group than for the quiescent group, the mean difference in the strength of the reflex between the groups was relatively small in each situation for each sex and for the subjects as a whole. This was particularly true when the difference was expressed in terms of per cent of body weight supported.

TABLE 1

GRIPPING STRENGTH IN POUNDS AND IN PER CENT OF BODY WEIGHT SUPPORTED IN THE THREE SITUATIONS: CLOTHED, NUDE, AND RECLOTHED

	Quiescent group						Activated group					
	37 Boys		46 Girls		Boys and girls		32 Boys		36 Girls		Boys and Girls	
Situation	Lbs.	% Wt. supported	Lbs.	% Wt. supported	Lbs.	% Wt. supported	Lbs.	% Wt. supported	Lbs.	% Wt. supported	Lbs.	% Wt. supported
Clothed												
Mean	4.4	42.6	4.5	50.3	4.5	46.8	4.6	41.5	5.0	52.9	4.8	47.6
Median	4.0	41.0	4.3	50.0	4.3	47.0	4.3	37.5	4.9	49.5	4.6	44.0
Sigma	2.1		1.4		1.8		2.0		1.7		1.8	
Nude												
Mean	6.5	64.4	6.0	66.3	6.2	65.4	6.3	58.6	6.5	67.6	6.4	63.4
Median	6.4	60.0	6 0	67.5	6.0	67.0	6.3	57.0	6.5	65.0	6.5	59.0
Sigma	3.0		1.7		2.4		1.9		2.0		2.0	
Reclothed												
Mean	4.8	47.7	4.5	50.0	4.6	49.0	5.2	47.7	5.1	54.2	5.2	51.2
Median	4.0	47.0	4.5	48.5	4.3	47.0	4.8	45.0	4.6	45.0	4.8	45.0
Sigma	2.1		1.4		1.8		2.2		1.9		2.0	

The data on per cent of body weight supported further indicate that the girls were superior in gripping strength to the boys in all situations. It will be noted that in most cases variations in gripping power were greater for the boys than for the girls.

The mean and median measures show that the greatest difference in strength of the response between the nude and clothed situations, and between the nude and reclothed situations, occurred in the quiescent group of boys. Differences between the clothed and reclothed situations were generally slight, with the average gripping force slightly greater in the latter situation.

Although the gripping response was on the average considerably stronger in the nude than in the clothed or reclothed situation, analysis of the data disclosed individual trends inconsistent with those of the group. Table 2 shows the frequency with which the strength of the response increased, decreased, or remained unchanged from one situation to another. The mean and median amounts of the increases and decreases for the groups are expressed in pounds.

The data indicate that for both quiescent and activated groups a large majority (over 75 per cent) of the subjects revealed the group trends, viz., stronger gripping power when nude than when clothed or reclothed. For both groups the increase in strength from the clothed to the nude situation exceeded that from the reclothed to the nude situation. Only a relatively small number of subjects (10-17 per cent) of each group revealed reverse trends. A few infants of each group failed to show any change in the strength of the reflex with change one way or the other in the condition of dress. It is significant that despite the great variations from subject to subject, the mean difference in strength between the nude and clothed situations, and between the nude and reclothed situations, is greater for subjects who revealed the group trends than for subjects who revealed the reverse trends. There was no significant difference in gripping power between the clothed and reclothed situations. About one-half of the subjects gripped harder when clothed; the other half gripped harder when reclothed.

More than two-thirds of the subjects of each group, 58 quiescent and 46 activated infants, exhibited the strongest grip in the nude situation, and in 12 other instances the grip in this situation was stronger than in one of the other situations. About 1/8 of the

TABLE 2

FREQUENCY AND AMOUNT OF INCREASE AND DECREASE IN GRIPPING STRENGTH FROM ONE SITUATION TO ANOTHER
(The mean and median measures of the amount of increase or decrease are in pounds)

	Clothed to nude				Reclothed to nude				Clothed to reclothed			
	No. cases	Mean	Median	Sigma	No. cases	Mean	Median	Sigma	No. cases	Mean	Median	Sigma
Quiescent group												
Increase	63	2.5	2.3	1.5	67	2.1	1.8	1.5	41	1.3	0.9	1.1
Decrease	14	1.0	0.9	0.5	11	0.9	0.7	0.9	34	1.1	0.8	0.8
No change	6				5				8			
Activated group												
Increase	53	2.2	1.9	1.5	54	1.7	1.7	1.2	33	1.6	1.4	1.2
Decrease	11	0.7	0.4	0.5	7	1.5	1.3	0.5	32	0.9	0.8	0.6
No change	4				7				3			

TABLE 3

CLINGING STRENGTH (IN POUNDS) OF CRYING AND OF NON-CRYING SUBJECTS

	Clothed				Nude				Reclothed			
	No. cases	Mean	Median	Sigma	No. cases	Mean	Median	Sigma	No. cases	Mean	Median	Sigma
Quiescent												
Crying	22	6.1	5.5	1.7	34	8.1	7.9	1.9	33	6.0	5.5	1.8
Non-crying	61	3 9	4.0	1.4	49	4.9	4.5	1.7	50	3.8	3.9	1.0
Activated												
Crying	11	6.3	6.5	1.3	25	7.4	7.5	1.8	19	6.4	6.8	2.0
Non-crying	57	4 5	4.3	1.8	43	5 8	6.0	1.8	49	4.7	4.5	1.8

subjects manifested their greatest strength when they were clothed, and less than 1/10 of them when they were reclothed.

It has been stated (11) that the grasping reflex functions more tenaciously in crying infants than in non-crying infants. In order to test the validity of this statement, the strength of grip was determined separately for subjects who cried during the tests and for subjects who did not cry. The results are presented in Table 3. It will be noted that the frequency of crying is highest in the nude situation and lowest in the clothed situation.

The data show that for both crying and non-crying subjects the power of grip was greater when infants were nude than when they were clothed or reclothed, and that in each of the three situations the grip was much stronger for the crying infants than for the non-crying infants. Comparison of Tables 1 and 3 indicates that in each situation the average gripping power of both quiescent and activated groups was substantially increased by the presence of infants who cried during the tests. The greater the frequency of crying, the greater the increase in the force of the grip.

Thirty-one subjects cried during each of the three tests. Their average gripping strength in each situation, viz., clothed 6.2 lbs., nude 7.8 lbs., and reclothed 6.1 lbs., differed very little from that of the entire crying group. Of these 31 infants, 16 supported the entire body weight when nude, three when clothed, and one when reclothed. One subject supported her full weight on all three occasions.

There were 39 instances, 20 in the quiescent group and 19 in the activated group, in which infants gripped with sufficient strength to support the body weight. The data show that in 33 of these instances the subjects were nude and that in 30 instances they were crying. The girls exhibited this superior gripping power on 26 occasions, and the boys on only 13 occasions. The 26 grips by the girls were achieved by 21 infants as follows: one girl in each of the three situations; three girls in each of two situations; 17 girls on only one occasion each. The 13 grips by the boys occurred only when the subjects were nude.

D. Discussion

1. *Evidence from the Literature*

Results of other investigations lead one to expect a difference in

the condition of tonus between the nude and the clothed situations. Irwin and Weiss (7) experimented with 50 infants by means of the stabilimeter-polygraph techniques and found that the group was twice as active when nude as when clothed. In addition, all but three of the infants "revealed trends consistent with the group findings" (7, p. 156). Several studies (1, 8, 9, 10) indicate that warmth had a quieting effect on infants, whereas cold appeared to stimulate them to action. In this connection it is generally accepted (5, p. 52) that external cold tends to bring about an increase in bodily metabolism and an augmented muscular tone. Pratt (9) reports a greater amount of activity by infants when the diapers are wet than when they are dry and believes that the difference in activity between the two situations is probably due to changes in temperature rather than in humidity. In an earlier study wherein clothing was not a factor Irwin (6) found that variations in body temperature between 96° and 101.6° did not materially affect the motility of infants. Henderson and his associates (4) compared the effects of still air and of agitated air on adult male subjects naked to the waist and discovered in the latter case a marked increase in muscular tonus and intramuscular pressure. The subjects lay quietly in a room in which temperature and humidity were constant. Furthermore, according to these investigators (4, p. 269) Barcroft (a reference we were unable to procure) "found that the fetus of a sheep delivered by Caesarean section in a warm bath has no tonus in its muscles until it is lifted out of the bath into the air; and that, if the cord is intact, the tonus disappears again when the fetus is replaced in the bath."

In view of the above findings and the results herein obtained, it is the opinion of the writer that in the present experiment the difference in strength of the clinging reflex between the nude and the clothed infants may best be accounted for by the differential physiological effects of changes in skin temperature. The evaporation of moisture from the skin has the effect of reducing its temperature and thereby reflexly exciting the muscles into a state of increased tonus (5). Inasmuch as evaporation occurs faster when the skin is uncovered, other conditions being equal, the excitation would be greater under nude than under clothed conditions.

2. *Inconsistent Results*

Reverse trends manifested by a relatively small number of subjects in each group are not easily explained. It can only be suggested that the procedure which was generally adequate to produce changes in the condition of tonus was also effective in producing changes in affective state which in some cases influenced the disposition to action. There is the probability that the stimulation from previous handling and testing was in some cases a more potent factor than clothing in determining the strength of the reflex in the reclothed situation.

3. *Affective Responses and Their Relation to Gripping Power*

The exclusion of crying and fretting infants made for greater uniformity in behavior during the pre-test periods and thus for more comparable results in the tests. Previous investigations (2) revealed that attempts to elicit the grasping reflex in emotionally disturbed subjects were frequently futile, and that even when such attempts were successful, great fluctuations in gripping power occurred unless a steady and forceful pull were maintained against the flexor tendons.

The tests evoked varying affective responses. Of the 453 tests, three per subject, 144 were attended by crying, 57 by smiling, and 252 by varying degrees of complacence or annoyance. The frequency of crying was higher for the quiescent group, whereas the frequency of smiling was higher for the activated group. However, it should be added that if the time limit for gripping had been extended, crying would probably have occurred in all cases in which subjects exhibited marked strength.

It has been noted that the mean gripping power of the crying subjects was considerably greater than that of the non-crying subjects. The simplest explanation of the marked strength exhibited by infants who cried during the tests is to ascribe the state of increased tonus to the energizing effects of emotional excitement. The explanation suffices for instances in which the strength of the reflex increased with crying which started before the body was fully supported, but may not apply to instances in which crying occurred only after the body was suspended. It seems highly probable that in the latter instances, and in the case of non-crying infants, strong gripping occurred as a result of a previously induced state of increased tonus

and that the crying which ensued was occasioned by fear, postural discomfort, or severe muscular strain. Crying during the eaıly stages of the pull appeared to be due to interference with the preferred supine posture.

4. *Reasons for Sex Differences*

Three reasons may be advanced for the general superiority in gripping strength of the girls over the boys. In the first place, crying during the tests was relatively more frequent among the girls than among the boys. The difference between the sexes may be due to the greater age of the boys, inasmuch as it is generally accepted that the grasping reflex weakens with age. On the other hand, the difference may be due to strict obseıvance of the conditions imposed by the procedure which resulted in the elimination of numerous prospective subjects, the majority of whom were boys. This is equivalent to saying that the girls as a whole experienced less difficulty than the boys in their adjustment to the experiment.

5. *Individual Differences*

In any one of the three situations, both boys and girls exhibited marked individual differences in muscle tonus. Marked individual differences in tonus were exhibited also from one situation to another.

That the condition of muscle tonus varied greatly from subject to subject in each situation is indicated by the range of gripping strength. The range for the two groups in each of the three situations is given in Table 4. It was evident that some of the subjects

TABLE 4

Quiescent group		Activated group
0-0- 9.3 lbs.	Clothed	1 0- 9.3 lbs.
2.3-11.8 lbs.	Nude	1.5-11.2 lbs.
1.0-10.8 lbs.	Reclothed	1.8-11 0 lbs.

could have supported more than the body weight. If the full strength of these infants had been ascertained, individual differences would have been even more marked.

There was a relatively large number of subjects who consistently exhibited a strong grip, while an equally large number consistently exhibited a weak grip, in all three trials—an indication that factors otheı than the presence or absence of clothing were operative in

determining the state of tonus. As a rule, a subject's performance in the clothed situation was predictive of his performance in the nude and reclothed situations.

It has been noted that the change in condition from clothed to nude produced a state of increased tonus in more than 75 per cent of the subjects in each group. However, the amount of the increase, measured in terms of pounds of gripping strength, varied greatly from infant to infant, viz., from 0.5 to 7.9 for the quiescent group and from 0.6 to 7.1 for the activated group. A small number of subjects of each group showed no change in gripping power, whereas a somewhat larger number showed a decrease. The amount of decrease in no case exceeded 2 lbs. Similar individual differences were shown in the change in muscle tonus from the nude to the reclothed situation.

E. Summary

The strength of the grasping reflex in infants under six months of age was tested successively in the clothed, nude, and reclothed situations for the purpose of determining the effect of clothing on muscular tonus. The subjects were divided into two groups, the quiescent and the activated. The investigation indicated:

1. For each group the change from the clothed to the nude situation resulted in a state of increased tonus and the change from the nude to the reclothed situation resulted in a condition of reduced tonus. This general trend was evidenced by more than two-thirds of the subjects of each group.

2. More than 75 per cent of the subjects of each group exhibited a stronger grip in the nude than in the clothed situation, and an equal number of each group gripped with greater force in the nude than in the reclothed situation.

3. There was no appreciable difference in tonus between the clothed and the reclothed situations for either group.

4. The reflex was in general manifested with somewhat greater strength by the activated group than by the quiescent group.

5. Crying brought about a generally increased tonic state. As a whole, subjects who cried during the tests exhibited greater gripping power than did the non-crying subjects.

6. The girls were generally superior to the boys in gripping

strength. Three factors which may account for this difference between the sexes have been advanced.

7. Both groups revealed marked individual differences (*a*) in gripping strength in each of the three situations, and (*b*) in alterations in gripping strength with change in the condition of clothing.

8. The difference in the strength of the reflex between the nude and the clothed situations is due in part to changes in skin temperature.

References

1. Canestrini, S. Über das Sinnesleben des Neugeborenen. Berlin: Springer, 1913. Pp. 104.
2. Halverson, H. M. Infant sucking and tensional behavior. *J. Genet. Psychol.*, 1938, **53**, 365-430.
3. ———. Studies of the grasping responses in early infancy: I, II, III. *J. Genet. Psychol.*, 1937, **51**, 371-449.
4. Henderson, Y., Oughterson, A. W., Greenberg, L. A., & Searle, C. P. Air movement as a stimulus to the skin, the reflex effects upon muscle tonus, and indirectly upon the circulation of the blood; also the effects of therapeutic baths. *Amer. J. Physiol.*, 1936, **114**, 269-272.
5. Howell, W. H. A textbook of Physiology. (11th edit.) Philadelphia: Saunders, 1930. Pp. 1099.
6. Irwin, O. C. Motility of young infants: I. Relation to body temperature. *Amer. J. Dis. Child.*, 1933, **45**, 531-533.
7. Irwin, O. C., & Weiss, L. A. The effect of clothing on the general and vocal activity of the newborn infant. In *Studies in Infant Behavior*, by Irwin, O. C., Weiss, L. A., & Stubbs, E. M. *Univ. Iowa Stud.*, 1934, **9**, 151-162.
8. Peiper, A. Die Hirntätigkeit des Säuglings. Berlin: Springer, 1928. Pp. 102.
9. Pratt, K. C. Note on the relation of temperature and humidity to the activity of young infants. *J. Genet. Psychol.*, 1930, **38**, 480-484.
10. Pratt, K. C., Nelson, A. K., & Sun, K. H. The Behavior of the Newborn Infant. Columbus, Ohio: Ohio State Univ. Press, 1930. Pp. xiii+237.
11. Sherman, M., Sherman, I., & Flory, C. D. Infant behavior. *Comp. Psychol. Monog.*, 1936, **12**, 1-107.

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A STUDY OF EXPERIMENTALLY INDUCED SHIFTS IN FOOD-PREFERENCE*[1]

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A considerable number of researches have apparently indicated that both animals and children are capable of making adequate dietary selections when they have access to a variety of foods under laboratory conditions. In one of the earlier studies, Evvard (4) observed that pigs thrived when allowed free choice of whole corn grain, meat meal, whole oats; linseed oil meal, wheat middlings, charcoal, limestone, salt and water. More recently, Richter, Holt, and Barelare (18) obtained favorable results with purified foods. Rats were allowed access to olive oil, casein, sucrose, cod liver oil, wheat germ oil, yeast, sodium chloride, calcium lactate, sodium phosphate, and potassium chloride. Growth, reproduction, and activity compared favorably with records of animals on the standard McCollum diet. In accounting for the results, these experimenters support the theory of chemotropisms which operate to induce cravings for specific substances. Mursell (11), who gave this theory explicit formulation, states that the odor-taste combinations preferred are of the substances needed for the promotion of chemical balance. Osborne and Mendel (12) reported that rats were able to make satisfactory choices when presented with pairs of diets differing in respect to amount and quality of proteins. That specific organic imbalances are associated with appropriate preferences was demonstrated by Richter and his collaborators in a series of experiments. Adrenalectomized rats not only ingest comparatively large amounts of salt (16), but also have a lowered taste threshold for this substance (13). When subjected to parathyroidectomy, rats prefer calcium lactate solution to water (15). In a study of the nutritional requirements of female animals during pregnancy and lactation, the data indicated comparatively large demands for protein and fat as well as for sodium chloride,

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sodium phosphate, and calcium lactate (14). Rats deficient in vitamin *B* showed a tendency to reject carbohydrate and protein, but selected large amounts of fat and yeast (19). With vitamin B_1 deficiency, rats drank large quantities of synthetic thiamin chloride (17). Shelling (20) observed that parathyroidectomized rats developed anorexia for high phosphorus (tetany inducing) diets, but would eat freely when the excess phosphorus was omitted.

Certain investigators are convinced that children, in spite of apparent peculiarities, are capable of making advantageous dietary selections. Katz (8) employed the free-choice technique to overcome temporary loss of appetite in her children. Davis (1) reported that newly weaned infants showed satisfactory development when they selected their own diets. Davis (2) also applied the self-selection technique to the feeding of older hospitalized children with favorable results. Sweet (21), on the basis of clinical observations, reported greater confidence in dietary selections made by children than in the choices made for them by parents.

The foregoing summary implies a high degree of competence on the part of both animals and children in making salubrious dietary selections. At the same time certain dietary abnormalities are well known. The regular eating of polished rice and the excessive use of corn products persist in spite of associated deficiency diseases. We do not know, however, how much of this may be charged to the pressure of peculiar social conditioning which outweighs the dictates of normal appetite. While various forms of pica appear to be dietary perversions, investigations have shown that the materials ingested are sometimes of a nature to alleviate dietary deficiencies. Substances eaten by men or animals include clay, chalk, iron, stones, wood, paper, ashes, string, and bones. That the consequences may be fatal as in the eating of scraps of iron by cattle attests the strength of the drive.

Inadequate selections of diet have been noted in several experiments with animals. Dove (3), working with chickens, observed wide individual differences in the capacity to make advantageous choices. While some thrived on a free-choice regimen, others developed deficiency diseases. Innate factors, Dove believed, were in part responsible for the differences. Kon (9) allowed rats a self-selection of caseinogen, sucrose (later changed to rice starch), and a

salt mixture. Added to this was an allowance of cod liver oil and a watery extract of brewer's yeast. Control animals, receiving the caseinogen, sucrose, and salts mixed together, were definitely superior in development. The difference between the diets of the two groups was mainly in the limited protein consumption of the experimental animals. Wilder (22) allowed rats maintained on a high calcium, low phosphorus rachitic diet to choose between the deficient diet and one which would relieve the rickets. For one problem the rats were required to traverse the longer of two paths to reach an antirachitic diet, the shorter leading to the rachitic diet. He also employed a simple choice technique. In most cases the rats did not select the adequate diet. Novelty, Wilder believed, was a strong factor in determining choices. Jukes (7) reported that chickens deficient in vitamins *G* and *A* did not choose sufficient amounts of diets capable of remedying the deficiencies.

An apparent conclusion from these studies is that while most animals select diets adequate to maintain normal development when they have access to a variety of natural foods, there are limitations in the capacity to make advantageous selections from specific artificial preparations. But the problem is more complicated than this generalization implies. In reviewing the factors governing individual preferences for food, Dove (3) includes the following: innate adaptive mechanisms, changes in bodily demands with age and function, individual differences in genetic make-up, specific maturation of capacity to discriminate food differences, habits hindering the search for new and superior foods, food jags, dissipation in food demands based on organic difficulties or special habits, social interactions affecting choices, and various accidental factors such as the relative abundance and variety of foods. As Dove suggests, the results of observations on food preferences cannot be interpreted simply in terms of the existence or non-existence of innate capacities to make adequate selections. Unusual or abnormal dietary habits should therefore be examined in the light of a variety of factors capable of determining their genesis.

The present study derived from an interest in dietary difficulties exhibited by children. Feeding difficulties occur frequently among their various behavior problems (5). McCarthy (10) reported that children with feeding problems had diets higher than average in

carbohydrates. Her study, however, did not show that the children demanded excess carbohydrates. The observations, nevertheless, suggested the following hypothesis to the present writer. If the tendency which children sometimes show of preferring desserts and sweets to a more balanced fare is associated with emotional upset, the children may actually be making justifiable choices since: (*a*) emotion is associated with inhibited digestion; (*b*) concentrated carbohydrates such as sucrose are relatively easily digested, this substance being inverted by hydrolysis in the stomach into two monosaccharides which are readily absorbed. In order to make at least a partial test of the hypothesis, specific attention was given to the question of the effects of emotional behavior in rats on their relative sugar consumption. Arranging an emotional situation proved to be no simple problem since the experimenter was primarily interested in socially conditioned reactions. The technique finally used was discovered by accident. The experimental animals were separated, each living in its own cage. On one occasion the experimenter placed two males in the same cage. After about 15 minutes of mutual exploratory behavior, they begin fighting. Tests with other animals yielded similar results of a more or less strenuous nature in 8 out of 10 cases. No extraneous agents appeared to be necessary to induce the belligerence, and the opportunity was presented of regularly obtaining emotional behavior. In order further to be certain of the results, four rats with consistent records of hostile aggressiveness were set apart as regular fighters. No records of eating were kept of this group of four, and they served only to induce emotional behavior in the experimental group.

In all, 16 Wistar albino rats were used in the experiment. Of these, four males, 97 to 110 days old, served as fighters as noted above; six males and two females 97 days old comprised the experimental group; and four males 73 days old were employed as controls. Each rat had its own cage, though it was possible for the animals to see each other since the cages were side-by-side on the laboratory shelves.

Both the experimental and the control groups were first conditioned to a rhythm of daily feeding which took place from 4:00 P.M. to 5:30 P.M. The diet consisted of Purina dog chow checkers supplemented by a weekly allowance of about 10 grams of lettuce per

animal.[2] The daily consumption was determined for each rat by weighing a pan of food before and after feeding. Since the food pans filled the eating compartments of the cages and crumbs could be gathered, the estimates of amounts eaten were considered reliable.

After the feeding on the standard ration had continued for three weeks, the experimental animals were given daily access to sugar. No sugar was given to the controls or to the group of fighters. The proportions of standard ration and sugar eaten by the experimental group were of course determined by the animals themselves. The experimental group having continued on the two-choice regimen from 30 to 40 days, took part in a series of fights distributed over a period of two weeks. A total of 50 encounters took place. One of the experimental animals, No. 3, was not forced to fight because of its lack of aggressiveness. Each of the seven remaining animals took part in 5 to 10 fights. Sometimes the animals fought daily. At other times, when recovery appeared to be necessary, fights were postponed for several days. Since only four encounters could take place at a time, the result was a fairly haphazard distribution of the days of fighting. The procedure was to place an experimental animal in the cage of a fighter, and to leave the pair together for a half hour before the scheduled feeding. The experimental animal was then removed to its home cage where it had access to the sugar and standard ration. Following the period of fighting, the experimental group continued on the two-choice diet for an additional 20 to 30 days.

An outstanding characteristic of the individual records is their day-to-day variability. Figure 1 gives an indication of this phenomenon for two animals. Inasmuch as the writer has encountered a similar tendency in earlier experiments, the fact does not appear to be related to conditions peculiar to the present study. In treating the data, resort was made to the device of averaging the daily records of each rat for successive 5-day intervals for all times except the period of fighting. For this period averages were computed only for the days on which fights occurred. Tables 1 and 2 summarize the data of the experiment. Table 1 contains a record of average daily total consumption of food, i.e., weight of standard ration plus

[2]This ration has regularly been used in the laboratory in which the experiment was conducted.

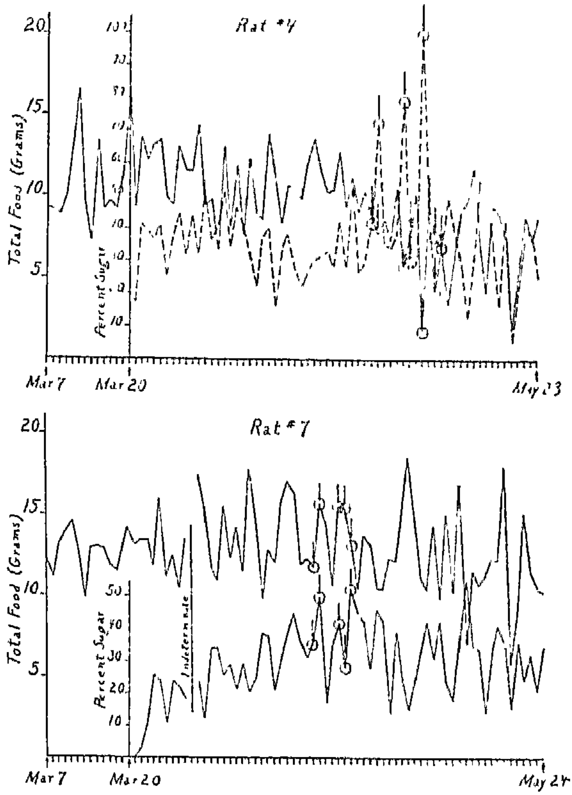

FIGURE 1

RECORDS OF TOTAL FOOD AND PER CENT SUGAR CONSUMED BY TWO EXPERIMENTAL ANIMALS

Sugar feeding began March 20. Arrows indicate days on which fighting took place.

weight of sugar. The averages of these averages show a tendency toward decrement as the experiment progresses. The data permit no generalizations, however, on the effects of fighting. In respect to the tendency toward a decrease in total food consumption, the experimental animals differed from the controls. Though records of eating of the control group (fed only the standard ration) were not kept until the 4th period before fighting of the experimental group, their averages of averages (total daily consumption in grams per rat) for successive 5-day periods during which records were

TABLE 1

AVERAGE DAILY TOTAL CONSUMPTION OF FOOD IN GRAMS BY RATS DURING SUCCESSIVE PERIODS OF THE EXPERIMENT

5-day periods before fighting	Rat No. 1	Rat No. 2	Rat No. 3	Rat No. 4	Rat No. 5	Rat No. 6	Rat No. 7	Rat No. 8	Averages of averages
1	18.9	12.9	14.9	12.9	15.8	13.9	13.2	19.7	15.3
2	16.9	12.4	14.7	11.5	15.7	15.0	12.7	17.3	14.5
3	15.8	9.8	13.1	11.0	13.8	16.1	15.2	16.6	13.9
4	15.5	10.9	13.2	9.8	14.9	15.3	14.1	15.5	13.7
5	17.0	10.5	13.3	10.5	15.2	12.9	13.5	16.4	13.7
6	16.1	12.1	15.2	11.0	14.5	14.6	13.5	17.0	14.3
7				10.8		14.7		17.7	—
Period of fighting	17.1	10.0	(14.9)[1]	6.9	13.5	11.6	14.3	11.8	12.2
5-day periods after fighting									
1	12.9	10.4	(12.4)	8.1	12.0	11.5	11.6	12.0	11.2
2	15.3	12.4	(11.6)	7.4	10.7	11.5	14.7	14.3	12.3
3	10.6	9.2	(12.7)	6.4	10.2	10.8	11.7	11.9	10.1
4	12.4	9.5	(12.3)	6.8	10.8	11.2	11.3	11.8	10.5
5	11.7	7.7	(10.7)				11.7		—
6	11.2	9.5	(11.3)				11.4		—

[1]Animal did not fight during this period. This and subsequent figures for Rat No. 3 are not included in averages of averages.

TABLE 2

AVERAGE SUGAR CONSUMPTION BY RATS DURING SUCCESSIVE PERIODS OF THE EXPERIMENT IN TERMS OF PER CENT WEIGHT OF TOTAL FOOD CONSUMED

5-day periods before fighting	Rat No. 1	Rat No. 2	Rat No. 3	Rat No. 4	Rat No. 5	Rat No. 6	Rat No. 7	Rat No. 8	Averages of averages
1	14.9	21.1	18.5	31.1	14.6	13.6	7.9	11.7	16.7
2	20.5	13.1	14.1	36.0	27.2	7.1	19.7	22.0	20.0
3	26.8	26.7	22.2	44.1	27.8	32.4	25.7	27.5	29.2
4	20.4	18.6	18.6	35.3	32.2	28.3	25.0	35.4	26.7
5	23.9	28.3	23.8	33.3	31.3	35.9	32.7	29.5	29.8
6	26.7	36.7	28.7	27.9	33.9	39.5	37.4	35.4	33.3
7				37.3		34.8		32.2	
Period of fighting	31.6	39.6	(25.8)[1]	52.9	35.2	36.4	41.4	46.6	40.5
5-day periods after fighting									
1	37.4	40.8	(28.1)	30.8	28.3	27.0	40.6	54.2	37.0
2	31.7	32.2	(30.2)	41.1	14.8	28.8	23.5	36.1	29.7
3	32.5	26.5	(30.3)	26.3	24.9	36.5	34.7	31.2	30.4
4	28.1	38.5	(24.9)	30.4	26.1	33.0	35.1	30.0	31.6
5	30.2	32.3	(27.5)				27.9		
6	30.3	31.4	(27.3)				29.4		

[1]Animal did not fight during this period. This and subsequent figures for Rat No. 3 are not included in averages of averages.

kept are as follows: 13.8, 14.3, 14.6, 14.0, 15.9, 15.6, 14.5, 15.1. At first the control and experimental animals ate approximately the same weight of food. As the experiment progressed, however, the experimental animals consumed less than the controls. In terms of calories, the individuals of the experimental group initially consumed roughly two or three more than the controls. Finally, the experimental animals were receiving roughly 10 calories less per animal than the controls. In spite of this, no significant differences in the development of body weight between the two groups could be detected. At the start of the experiment, all animals were between 5 per cent and 15 per cent above the comparable norms of the Wistar Institute (6). At the end, an animal from each gıoup had fallen about 5 per cent below the norms. It is likely that trends might have been revealed through the use of larger groups, or they might have become evident if the experiment had been continued over a longer period. There may have been differences in activity, and records of running would have constituted a valuable addition to the data. It is interesting to note that though Rat No. 3 did not take part in the fighting, this animal shared in the general decrease in total eating.

Table 2 shows the average per cent sugar consumption of the experimental animals. The data indicate that the group consumed relatively less sugar at first, and that the proportion tends to increase until a level of roughly 30 per cent is attained. Does this proportion of sucrose mean that the rats chose an unbalanced diet? On the basis of evidence available to the writer there are no data giving proof of an ideal diet. That rats show satisfactory development on a specified regimen does not preclude the possibility of an even better diet. Richter's (18) rats chose a 20.0 carbohydrate caloric percentage on the self-selection basis, and compared favorably in development with rats on the McCollum ration consuming 59.2 per cent carbohydrates. The percentage for the Purina checkers used in this experiment is 61.2. By eating 30 per cent sugar, the rats raised the figure to 73.8.[3]

[3]The following caloıic percentages of fat, protein, and caıbohydrate have been compiled to show the ıange in diffeıent diets. Self-selection (Richter, 18): 64.0, 16.0, 20.0; McCollum ration (Richteı, 18): 14.1, 26.7, 59.2; Purina dog checkers (data from dealeı): 12.7, 26.1 61 2; this experiment (30 per cent sugar) 8.6, 17.6, 73.8.

As to whether or not the fighting was associated with greater than normal sugar consumption, the data show a tendency in this direction in spite of individual variability. This is indicated by the fact that the over-all average per cent sugar consumption is greatest for the period of fighting. We note, however, that three of the rats, Nos. 1, 2, and 8, have the highest percentages for the first period after fighting, and that one rat, No. 6, has the highest percentage the second period before fighting. While there is no plausible explanation for the case of rat No. 6, it is possible that some types of conditioning were established in rats Nos. 1, 2, and 8. Nos. 1 and 2 may have responded to the auditory stimuli of the fighting of other rats, and temporal conditioning may have become established in all three. At least, for all seven animals who took part in the fighting the relative sugar consumption is appreciably greater for the period of fighting than it was for the last period before fighting. Furthermore, if the temporal conditioning is a factor, it is subject to an expected experimental extinction. There appears to be a general tendency to return to an optimal level of relative sugar consumption.

Considering the day-to-day variability of all the animals, it is evident that certain factors were not under control. In so far as the data allow conclusions, however, the conclusions are at least consistent with the hypothesis which the experiment was designed to test. The group tended to consume relatively more sugar during the over-all period of emotional excitement. Furthermore, the group consumed relatively more sugar as the experiment progressed. There is no certain explanation of this latter fact. If the consumption of sugar which brought about a carbohydrate caloric percentage of about 74 involved a dietary inadequacy, the chemotropistic theory of Mursell needs qualification. In this case, the experiment demonstrates factors capable of modifying the effectiveness of mechanisms responsible for dietary regulation. Wilder (22) has commented on the factor of novelty in the determination of food-preferences. In other words, an animal shows a tendency to vary its responses when variation is possible. The two-choice situation enhanced the strength of sugar as a competing stimulus. Richter's (18) rats on the free-choice regimen had a caloric percentage of only 20 when the carbohydrate sugar was used. The fact that the animals in the

present experiment reached a carbohydrate caloric percentage of about 74 may indicate that they made organic adjustments to the high carbohydrate diet, and that the altered metabolic processes became a habit. Thus, the artificial conditions of the experiment may have favored the formation of habits of inadequate choice.

The question may be raised as to whether the tendency to increase relative sugar consumption might have been a consequence of chronic emotionality brought about by the solitary confinement. An affirmative answer would constitute evidence for the initial hypothesis. The experiment furnished no data, however, to imply a chronic upset on the part of the rats. Further experimentation is necessary to supply information on this point.

Summary and Conclusions

1. When a group of eight rats, each in a separate cage, were allowed access to sugar and to a standard mixed ration, their relative consumption of sugar increased from an initial 16.7 per cent to a level of approximately 30 per cent.

2. The experimental animals exhibited belligerent behavior when placed together, and a series of fights was staged between the experimental animals and a second group of four animals also kept in individual cages. Only two animals fought together at a time.

3. There appeared to be a tendency for the experimental animals to increase their relative sugar consumption after fighting.

4. The experimental animals compared favorably in growth as judged by weight with a third group of four control animals kept in individual cages and fed the standard ration alone.

References

1. Davis, C M. Self-selection of diet by newly weaned infants. *Amer. J. Dis. Child.*, 1928, **36**, 651-679.

2. ———. A practical application of some lessons of the self-selection of diet study to the feeding of children in hospitals. *Amer. J. Dis. Child.*, 1933, **46**, 743-750.

3. Dove, W. F. A study of individuality in the nutritive instincts and of the causes and effects of variations in the selection of food. *Amer. Nat.*, 1935, **69**, 469-544.

4. Evvard, J. M. Is the appetite of swine a reliable indication of physiological need? *Proc. Iowa Acad. Science*, 1915, **22**, 375-403.

5. FOSTER, J. C., & ANDERSON, J. E. The young child and his parents. Minneapolis: Univ. Minnesota Press, 1930. Pp. 247.

6. GREENMAN, M. J., & DUHRING, F. L. Breeding and Care of the Albino Rat for Research Purposes. Philadelphia: Wistar Institute, 1931. Pp. 121.

7. JUKES, C. L. Selection of diet in chicks as influenced by vitamins and other factors. *J. Comp. Psychol.*, 1938, **26**, 135-156.

8. KATZ, R. Zur Psychologie der Ernährung des Kindes. *Arch. f. d. ges. Psychol.*, 1928, **65**, 292-320.

9. KON, S. K. The self-selection of food constituents by the rat. *Biochem. J.*, 1931, **25**, 473-482.

10. MCCARTHY, D. Children's feeding problems in relation to the food aversions of the family. *Child Devel.*, 1935, **6**, 277-284.

11. MURSELL, J. L. Contributions to the psychology of nutrition: I. Hunger and appetite. *Psychol. Rev.*, 192[illegible], [illegible], 3[illegible]-33[illegible].

12. OSBORNE, T. B., & MENDEL, L. B. The choice between adequate and inadequate diets as made by rats. *J. Biol. Chem.*, 1918, **35**, 19-27.

13. RICHTER, C. P. Salt taste thresholds of normal and adrenalectomized rats. *Endocrinology*, 1939, **24**, 367-371.

14. RICHTER, C. P., & BARELARE, JR., B. Nutritional requirements of pregnant and lactating rats studied by the self-selection method. *Endocrinology*, 1938, **23**, 15-24.

15. RICHTER, C. P., & ECKERT, J. F. Increased calcium appetite in parathyroidectomized rats. *Endocrinology*, 1937, **21**, 50-54.

16. ———. Mineral metabolism of adrenalectomized rats studied by the appetite method. *Endocrinology*, 1938, **22**, 214-224.

17. RICHTER, C. P., HOLT, JR., L. E., & BARELARE, JR., B. Vitamin B_1 craving in rats. *Science*, 1937, **86**, 354-355.

18. ———. Nutritional requirements for normal growth and reproduction in rats studied by the self-selection method. *Amer. J. Physiol.*, 1938, **122**, 734-744.

19. RICHTER, C. P., HOLT, JR., L. E., BARELARE, JR., B., & HAWKES, C. D. Changes in fat, carbohydrate and protein appetite in vitamin *B* deficiency. *Amer. J. Physiol.*, 1938, **124**, 596-602.

20. SHELLING, D. H. Calcium and phosphorus studies: I. The effect of calcium and phosphorus of the diet on tetany, serum calcium, and food intake of parathyroidectomized rats. *J. Biol. Chem.*, 1932, **96**, 195-214.

21. SWEET, C. Voluntary food habits of normal children. *J. A. M. A.*, 1936, **107**, 765-768.

22. WILDER, C. E. Selection of rachitic and antirachitic diets in the rat. *J. Comp. Psychol.*, 1937, **24**, 547-577.

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SEASON OF BIRTH AND INTELLIGENCE*

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Several studies have shown that the mean *IQ* of children born during the winter months is slightly lower than the mean *IQ* of those born during other seasons of the year. Huntington (1) has studied many problems connected with the season of birth. He postulates a basic animal rhythm which influences the number of births at various seasons of the year. He finds, furthermore, that the births of persons of unusual genius conform to this basic animal rhythm. If we assume that children with high *IQ*'s are likely to make up the larger portion of eminent people of the future, it would be reasonable to suppose that a preponderance of births of such children should approximate Huntington's basic curve showing a maximum during the winter months of January, February, and March. Huntington does not find this to be the case. He gives one curve for 3546 school children with *IQ*'s of 130 or more (1, p. 324). The maximum here occurs in April, with another, much lower, peak in August. The minima occur in January, June, and December.

We have taken our previous data (2) consisting of 17,502 *IQ*'s and re-grouped them in order to see what light they might throw upon Huntington's hypothesis of eminence and the basic animal rhythm. We have divided our total number of cases into four approximately equal groups of about 4,000 cases each. Group I contains the highest *IQ*'s; Group II the next highest, and so on. The limiting points for these groups, together with the number of cases are indicated in Table A.

TABLE A

Group	*IQ* Range	*N*
I	115 to 199	4,960
II	100 to 114	4,523
III	85 to 99	4,405
IV	45 to 84	3,615
Total	45 to 199	17,502

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TABLE 1
MONTH OF BIRTH OF CHILDREN WITH *IQ*'S FROM 115 TO 199

Month	*N*	*N* Days	*N* Per Day	%	*S* %
January	401	31	12.9	94.8	93.1
February	359	28¼	12.7	93.4	95.0
March	416	31	13.4	98.5	99.0
April	438	30	14.6	107.3	102.7
May	413	31	13.3	97.8	101.3
June	418	30	13.9	102.2	102.8
July	458	31	14.8	108.8	104.9
August	422	31	13.6	100 0	105.3
September	458	30	15.3	112.5	105.1
October	404	31	13.0	95.6	100.2
November	396	30	13.2	97.0	94.8
December	377	31	12.2	89.7	97.8
Total	4960	365¼	13.6		

TABLE 2
MONTH OF BIRTH OF CHILDREN WITH *IQ*'S FROM 100 TO 114

Month	*N*	*N* Days	*N* Per Day	%	*S* %
January	398	31	12.8	103.2	101.2
February	388	28¼	13.7	110.5	108.5
March	423	31	13.6	109.7	108.7
April	391	30	13.0	104.8	103.6
May	366	31	11.8	95.2	98.6
June	370	30	12.3	99.2	98.4
July	386	31	12.4	100.0	99.2
August	375	31	12.1	97.6	100.2
September	392	30	13.1	105.6	101.2
October	370	31	11.9	95.9	95.7
November	327	30	10.6	85.5	88.7
December	337	31	10.9	87.9	91.2
Total	4523	365¼	12.4		

TABLE 3
MONTH OF BIRTH OF CHILDREN WITH *IQ*'S FROM 85 TO 99

Month	*N*	*N* Days	*N* Per Day	%	*S* %
January	411	31	13.3	109.9	107.2
February	373	28¼	13.2	109.0	107.6
March	385	31	12.4	102.4	104.9
April	383	30	12.8	105.8	100.8
May	336	31	10.8	89.2	93.9
June	334	30	11.1	91.7	93.3
July	379	31	12.2	100.8	99.8
August	398	31	12.8	105.8	101.9
September	344	30	11.5	95.1	95.9
October	329	31	10.6	87.6	92.1
November	357	30	11.9	98.3	96 0
December	376	31	12.1	100.0	102.1
Total	4405	365¼	12.1		

TABLE 4
MONTH OF BIRTH OF CHILDREN WITH *IQ*'S FROM 45 TO 84

Month	*N*	*N* Days	*N* Per Day	%	*S* %
January	349	31	11.3	114.1	108.5
February	332	28¼	11.8	119.2	115.1
March	332	31	10.7	107.9	107.2
April	280	30	9.3	93.9	98.2
May	297	31	9.6	96.9	94.9
June	274	30	9.1	91.9	95.4
July	309	31	10.0	101.0	99.2
August	315	31	10.2	103.0	102.0
September	301	30	10.0	101.0	101.0
October	303	31	9.8	99.0	96.2
November	256	30	8.5	85.8	89.4
December	266	31	8.6	86.8	93.4
Total	3614	365¼	9.9		

TABLE 5
MONTH OF BIRTH OF ALL CASES

Month	*N*	*N* Days	*N* Per Day	%	*S* %
January	1559	31	50.3	105.0	102.1
February	1452	28¼	51.4	107.3	106.1
March	1556	31	50.2	104.8	105.2
April	1492	30	49.7	103.7	101.8
May	1412	31	45.5	94.9	98.7
June	1396	30	46.5	97.1	98.1
July	1532	31	49.4	103.1	101.3
August	1510	31	48.7	101.7	102.6
September	1495	30	49.8	103.9	101.1
October	1406	31	45.4	94.8	96.6
November	1336	30	44.5	92.9	93.0
December	1356	31	43.7	91.2	95.1
Total	17,502	365¼	47.9		

We have employed Huntington's method of treating the data for the purpose of making smoothed curves. The data are presented in Tables 1-5, and the method can best be explained by taking Table 1 as an illustration. The first column gives the month of birth, the second shows the number of cases born in each month, the third column gives the number of days per month, the fourth gives the number of births per day for each month. At the bottom of this column we find the number of births per day for the whole year. The fifth column gives the number of births per day expressed as a percentage of the daily average for the whole year. In Table 1 the

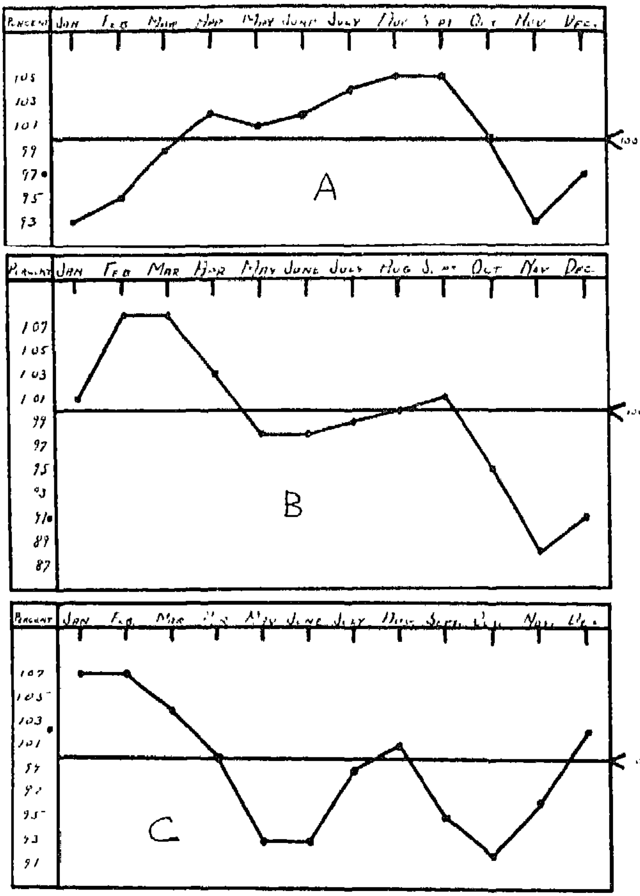

FIGURE 1

A. Group I, *IQ* Range 115-199.
B. Group II, *IQ* Range 100-114.
C. Group III, *IQ* Range 85-99.

daily rate in January is 94.8 per cent of the daily rate for the whole year. The last column, headed *S* %, is the smoothed percentage according to Huntington's method, e.g., the smoothed percentage for January is December+2 January+February divided by 4, and similarly for the other months.

From the smoothed percentages in the last columns of these five

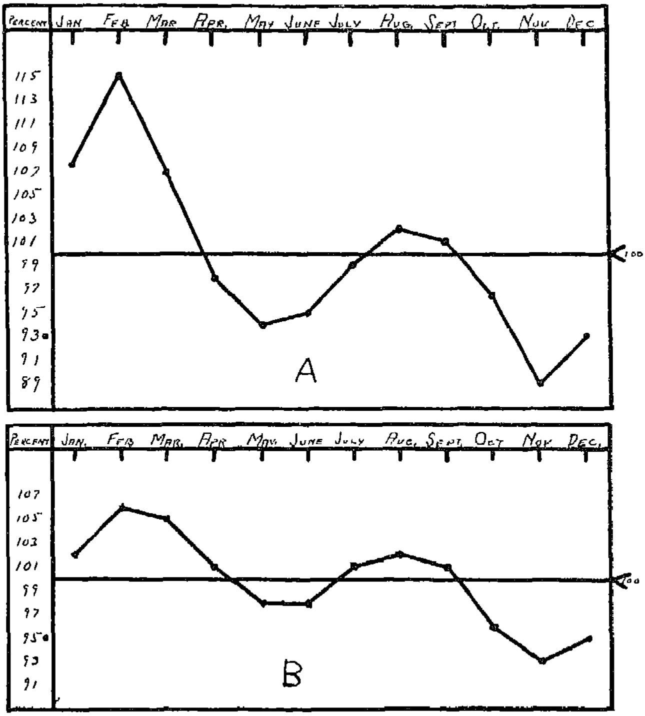

FIGURE 2

A. Group IV, *IQ* Range 45-84.
B. Total Group, *IQ* Range 45-199.

tables have been constructed the two graphs. Figure 2B shows the basic graph for our total of 17,502 cases. The highest peak occurs in the winter months with a secondary peak in the summer. This basic curve is somewhat like many of Huntington's curves demonstrating his "basic animal rhythm of reproduction."

A comparison of Figures 1 and 2 shows a notable deviation of the curve for the highest *IQ*'s from the curves for the other three groups. This high *IQ* curve shows no peak for the winter months (January, February, March) as it should do to conform to Huntington's hypothesis. The other three curves are similar in shape, all showing the highest peak in the winter months with a secondary peak in the summer. It should be noted, however, that Figure 2A, the curve for

the low *IQ*'s, shows the most pronounced peak of all in the winter months.

References

1. Huntington, E. Season of Birth. New York: Wiley, 1938.
2. Pintner, R., & Forlano, G. The influence of month of birth on intelligence quotients. *J. Educ. Psychol.*, 1933, **24**, 561-584.

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SUPINE LEG AND FOOT POSTURES IN THE HUMAN INFANT IN THE FIRST YEAR OF LIFE*

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A. INTRODUCTION

A general description of the supine behavior of the human infant in the first year of life has been given in *Infant Behavior: Its Genesis and Growth* (3, pp. 49-61). This treatment includes percentages of occurrence for different behavior of head, arms, legs, and trunk, in infants of the Yale Normative Group. For general orientation the reader is referred to this study. A pictorial designation of supine postures characteristic of monthly age levels during the first year is presented in the *Atlas of Infant Behavior* (5, pp. 50-89). Since both of these studies deal chiefly with total body responses and with the most conspicuous aspects of these responses, arm, head and trunk behavior have been stressed rather than the seemingly less significant leg and foot postures.

Thus although *Infant Behavior* gives normative percentages for 14 different supine leg and foot postures, it does not give a detailed and exact description of the leg postures which are most characteristic of each age level. Just as arm postures are sometimes neglected in a study of prone behavior (1, p. 453), so legs have to some extent been neglected in studies of supine.

The present paper presents a detailed survey of leg, foot, and toe postures of a selected group of the Yale normative infants, at monthly intervals from 4 to 52 weeks. Cases selected are those for which detailed cinema records were available. From 13 to 42 cases were available at each age. All cases were first reviewed to obtain a general picture of growth changes. Then all records were analyzed cross-sectionally to obtain percentages of occurrence for each behavior at each age. For the benefit of readers who desire a fairly complete report, the following descriptive summaries for monthly age levels

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are introduced here. Each summary is itself recapitulated in a brief summary.

B. Descriptions of Behavior at Monthly Age Levels

1. *Four Weeks (14 Cases)*

a. Legs. The two outstanding *positions* at this age are legs flexed and outwardly rotated, heels on surface (occurs in 100% of cases),[1] with feet either everted (57% of cases), or soles opposed (57% of cases); and both legs extend (occurs in 100% of cases), feet predominantly inverted (57% of cases). However, though any one child both flexes and extends his legs, legs are predominantly flexed at this age in 78 per cent of cases.

The most conspicuous *behavior* at this age is the apparently reflex flexion and extension of one leg, foot tending to flex or extend passively as the leg flexes or extends; the passive leg remaining somewhat flexed with foot everted. This behavior occurs in 100 per cent of the cases.

There are just a few different behaviors at this age. The behavior picture is much the same from child to child, differing chiefly in the amount of activity, that is, the amount of flexion and extension of the active leg. In spite of the large amount of bilateral flexion and bilateral extension, this age may be considered chiefly a unilateral age because of flexion and extension of the active leg.

Occasionally both legs flex up off the floor a little, soles opposed (21%), or soles toward camera[2] (43%). Rolling of trunk to side is prominent (57% of cases).

b. Feet. Are for the most part passively flexed, heels in, toes out, as legs flex; or leg position may bring soles of feet toward each other. Feet do not seem to be independently active at this age, but come to extension as legs extend and may be inverted slightly.

c. Toes. Are very active at this age. Flexion, and also dorsal extension (that is fanning combined with backward extension) both occur in 100 per cent of the cases. The Babinski reflex is seen in

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[1]Percentages given throughout indicate per cent of cases in which the behavior was observed, not per cent of time in which cases exhibited the behavior.

[2]Camera is just above body level, at the foot end of the child and is directed toward child's feet.

57 per cent of cases. Simple extension occurs only infrequently. Toes of the extensor leg tend to extend dorsally while toes of the flexed leg remain flexed.

d. Summary. One leg flexes and extends, other leg remaining flexed; or both legs flex; or both legs extend. Feet flex passively, everted or inverted. Toes are active. They flex, extend dorsally, or exhibit the Babinski reflex.

2. *Eight Weeks (38 cases)*

a. Legs. Behavior is much like that at four weeks except that there is not as much activity. Legs maintain their positions longer. Activity does not appear to be quite as reflex.

Activity seen most is flexion and extension of the face leg (71% of cases). Usually other leg is extended with foot everted, but it may be flexed with foot everted. Both legs extend with feet straight (39%), with feet everted (55%), with feet inverted (31%). Both legs flex in outward rotation (frogged) with feet everted (68%), inverted or with soles opposed (50%). Sometimes legs frog and one foot is in step position, other everted (55%). Occasionally both legs flex up, soles toward camera (42%). Less often they both extend up slightly off floor. As one leg flexes and extends it may bring foot to opposite knee. This seems to be largely reflex. Leg activity seems to determine foot position. Though legs are predominantly extended rather than flexed in 63 per cent of the cases, the unilateral flexion and extension of one leg gives this age like four weeks a unilateral aspect.

b. Feet. Move passively, depending largely on leg movement. For the most part feet flex and evert, soles perpendicular to floor from out to inner side of foot. But as legs extend somewhat, feet may be moved from an everted position to an inverted one, feet still perpendicular to floor and in nearly the same relation to leg. Ankles are not mobile.

c. Toes. Are active though less so than at four weeks. One hundred per cent of the cases still exhibit flexion, which is the predominant behavior. Dorsal extension occurs in 63 per cent of the cases, Babinski in 72 per cent, simple extension in 80 per cent.

d. Summary. One leg flexes and extends, other leg extending with foot everted; legs both flex or both extend with feet everted. Toes are active. They flex, extend dorsally, or exhibit the Babinski.

3. *Twelve Weeks (42 cases)*

a. Legs. The most outstanding position at this age is bilateral leg flexion, legs outwardly rotated and feet inverted (69% of cases), or feet everted (52% of cases). A new trend, prominent from 12 through 44 weeks, is the flexion of both legs with knees together, which brings feet into step position (62% of cases). Legs flex upward soles more or less toward camera and toes usually upward (57% of cases). Traces of one leg flexion and extension still remain (26%), and sometimes one foot goes to other knee (26%). There is little leg extension. When it occurs feet may be straight (28%), everted (31%), or inverted (40%). Twelve weeks is an extremely flexor age in supine, 93 per cent of the cases exhibiting predominant leg flexion. Bilateral flexion, and the beginning of legs flex with knees together bringing feet to floor in step position, are perhaps the most important behaviors at this age, leading up as they do to patterns so conspicuous at 16 weeks (see Figure 4).

b. Feet. Do not appear to be independently active. As legs extend, feet are mostly inverted (40% as against 31% everted). Most predominant trend is legs flex feet inverted (69%). Feet are actually in much the same relation to leg as at earlier ages, but the fact that legs are flexed more loosely, though still outwardly rotated, causes foot inversion, though outer sides are still against supporting surface. As legs flex more sharply, feet may evert (52%); and as knees come together feet may be brought to step position (62%). Or legs may flex up, bringing soles toward camera, toes up (57%). Foot is not active at ankle. Foot-leg angle tends to be passive 90° or slightly more. Feet may curl slightly.

c. Toes. Are predominantly flexed, in 100 per cent of cases, but Babinski and simple extension both occur in 91 per cent of cases. Dorsal extension occurs in 58 per cent of cases.

d. Summary. Legs flex bilaterally in outward rotation, feet inverted or everted; or, for the first time, legs flex knees together feet in step position. Toes are predominantly flexed, but extension, dorsal extension and Babinski are still conspicuous.

4. *Sixteen Weeks (46 Cases)*

a. Legs. Sixteen weeks even more than 12 weeks is characteristically an age of bilateral flexion, but it is also characteristically an age

of many different leg positions. Six diffeient items descriptive of leg behavior have an incidence of over 40 per cent at this age. This in spite of the fact that there seems to be less leg activity than at 4 or 20 weeks. Bilateral frogging (extension at hips, flexion at knees) with feet opposed, occurs in 76 of the cases. Legs flex knees together, feet in step position (80%) reaches its peak at this age. Legs also flex up from the platform, knees apart, feet toward camera (52%), oi soles opposed (41%). One foot comes to other knee in 56 per cent of the cases, this being the first age at which this behavior has an incidence of over 50 per cent. Legs occasionally extend to one side, hips rolling slightly to one side. Normative figures give 50 per cent of the cases rolling to one side at this age, though midline positions predominate. Pivoting occurs for the first time (29%, normative figure). Behavior is piedominantly flexor (93% of cases) and predominantly bilateral, at this age. However in bilateral fiogging (76%) there is marked extension at the hips. Twelve weeks has in many behaviors anticipated the more important items of 16 weeks' behavior. Percentages for most important items are just a little higher than at 12 weeks (see Figure 4). Extensor items, however, are all smaller at 16 than at 12 weeks.

b. Feet. Soles opposed, feet perpendicular to floor outer to inner side (76%) as legs frog, or feet in step position (80%) as legs flex with knees together, predominate. Soles may be toward camera (52%) toes up, or soles may be opposed (41%) as legs flex up from platform. As one foot steps on other knee (56%), passive leg is flexed and foot inverted slightly so that sole of foot is almost in line with trunk. Feet are still very passive at ankles, leg positions largely determining foot positions.

c. Toes. Are predominantly in plain extension in 58 per cent of cases. In other cases they are predominantly flexed. Babinski drops to 41 per cent, dorsal extension to 50 per cent. Toes are much less active than previously.

d. Summary. Bilateral flexion predominates. Many diffeient leg postuies occur. Legs frog with soles opposed, flex with knees together and feet in step position, or (for the first time) one foot is planted on opposite knee. Toes aie mostly flexed or in plain extension.

5. *Twenty Weeks (34 Cases)*

a. Legs. Twenty weeks is much like 16 weeks in that it is predominantly an age of bilateral flexion. The chief difference seems to be that at 20 weeks legs are flexed up from the platform, feet toward camera (65%) or soles opposed (47%). Also, as legs flex up, knees are together and legs are pulled up toward the trunk, rather than being frogged with knees apart as earlier and later. There is considerably less frogging with legs and feet on floor and extension at hips than at 16 and 24 weeks. Here legs frog soles opposed (56%), and legs frog feet evert (38%). Legs may flex, knees together and feet in step position (65%). Legs extend to side (35%), there is rolling to one side (normative figure 59%), and legs extend up with soles opposed (23%). Also, though foot to knee occurs in a greater percentage of cases than formerly (73%, the most of any age), foot is at knee during more of each observed period at 16 weeks than at 20. At 20 weeks there occurs in some children a jerky flexion and extension of one or both legs not seen at 16 weeks. At 20 weeks legs seem more active than formerly, almost constantly moving, and moving quickly. Hips are active, rolling occurs, and legs extend to one side in 35 per cent of the cases. Pivoting occurs in 28 per cent of cases (normative figure). Holding of positions was conspicuous at 8 weeks; 16 weeks was an age of many different positions; 4 and 20 weeks are active ages.

b. Feet. Are becoming mobile at this age; there is more rotation of feet on ankles. Feet rotate in and out, also flex and extend, without the leg changing position. As legs flex up off floor soles may be toward camera (65%) or opposed (47%). As legs frog on surface there is still more foot inversion (56%) than eversion (38%). Foot may be planted on opposite knee, other leg as at 16 weeks semi-flexed with weight on outer side of foot and sole perpendicular to floor outer to inner side of foot, foot in line with body. Legs do not extend much but when they do feet are about equally often everted, inverted, or straight. Leg flexion, knees together, still frequently brings feet to floor in step position. Ankles cross as legs flex in 23 per cent of cases, the largest percentage of any age but 28 weeks. This may be due partly to leg position but coincides with increased mobility of ankles.

c. Toes. Flexor behavior occurs about evenly with simple exten-

sion, both being observed in 100 per cent of the cases. Babinski drops to 27 per cent; dorsal extension to 8 per cent. Toes are not active.

d. Summary. Bilateral flexion predominates. Legs flex up toward trunk, knees together, feet toward camera. Or flex with feet on floor in step position, or frog, or foot to knee. Legs are very active; there is more rotation at ankles; toes flex or extend.

6. *Twenty-Four Weeks (33 Cases)*

a. Legs. The predominant posture at this age is bilateral flexion, with legs in outward rotation (frogged). Legs may be frogged with extension at hips and feet on floor, inverted (66% of cases); or frogged with flexion at hips and feet and legs up from floor, still inverted (42%). As legs flex upward, knees are apart at this age, not close together as at 20 weeks. Legs flex, knees together and feet on floor in step position (51%). Rolling to the side is still frequent (49%, normative figure 62%). Foot to knee occurs in 42 per cent of the cases; legs extend feet inverted in 45 per cent of cases. Legs are predominantly flexed in 91 per cent of cases at this age, but there is predominant extension at hips. Postures are chiefly bilateral. Postures are held at this age; there is little activity, and what there is is not jerky as at 20 weeks. Occasionally pivoting is still seen (normative figure 21%); and bouncing of hips reaches its largest incidence (18%).

b. Feet. Are still predominantly inverted at this age, weight on outer sides of feet, soles perpendicular to floor from outer to inner side. As legs frog on the floor feet invert in 66 per cent of the cases, evert in only 33 per cent. As legs flex up from the floor soles are opposed in 42 per cent of the cases, feet evert in 24 per cent. Legs extend very little but when they do feet are inverted, soles toward floor more than in any other position (27%); heels only on the floor. Feet may rotate on ankles. Ankles occasionally cross, both in leg extension and leg flexion.

c. Toes. In all cases are predominantly in simple extension. Flexion is seen, however, in 83 per cent, Babinski in 58 per cent, dorsal extension in 8 per cent.

d. Summary. Legs flex bilaterally, knees apart, with extension at hips, and feet inverted on floor; or flex at hips up from floor, with feet inverted. Feet are inverted, but there is rotation at ankles. Toes extend.

7. *Twenty-Eight Weeks (15 Cases)*

a. Legs. At this age the child goes easily from one position to the other, the connection between positions is plain to observe, and there are few unclassifiable positions. Thus legs flex with knees together and feet in step position (45%); legs frog up off floor soles toward each other toes upward (86%); then both legs extend straight upward at right angles to the trunk. This is one of the predominant positions at this age. As legs extend upward feet may be inverted and soles opposed (62%), toes directly upward or pointed forward toward head; or soles may parallel floor (62%). Legs are still predominantly flexed in over half the cases though this percentage has dropped to 65 per cent. Positions are predominantly bilateral, and seem, as suggested, to be all part of the same movement, though child may hold any one position for some time. Foot to knee (unilateral behavior) still occurs prominently. Trunk is active: normative figure for rolling to side is 54 per cent.

b. Feet. Are very mobile at this age. As legs extend upward, feet change from soles opposed toes pointed upward or toward head (62%) to soles parallel to floor (62%) by rotation at ankles often without any leg movement. In the most frequent posture at this age, i.e., legs frogged upward, soles of feet are toward each other and toes point upward (86%). In 24 per cent of cases legs are frogged up and toes point straight up or outward, soles toward camera. As legs extend along floor the most prominent foot position is feet straight, heels on floor, soles toward floor (38%). Foot eversion predominates over foot inversion for the first time since eight weeks as legs extend on the floor, but inversion predominates slightly as legs flex.

c. Toes. At this age and at all following ages are predominantly in simple extension in 100 per cent of the cases, though other behaviors, notably flexion, do occur. Here flexion occurs in 81 per cent of cases, Babinski in 36 per cent, dorsal extension in 9 per cent. From this age on, dorsal extension occurs more as a sidewise fanning than as a backward extension.

d. Summary. Legs flex, feet in step position; frog up off floor soles opposed toes upward; legs extend straight upward soles opposed or parallel to floor. Foot comes to opposite knee. Feet are mobile, mostly everted as legs extend on floor, inverted as legs flex. Toes from now on are predominantly in simple extension.

8. *Thirty-Two Weeks (15 Cases)*

a. Legs. The same behaviors predominate at this age as at 28 weeks. For the most part legs extend up, soles opposed (52%) or parallel to the floor (55%), but there is considerable frogging upward with soles opposed, or toward each other and toes up (55%). The percentages are all slightly smaller than at 28 weeks. There is less foot to knee than at 28 weeks (only 41%); about the same amount of legs extending to one side (27%). Legs are extended at this age more than flexed (72% have legs predominantly extended), but for any individual case it is often difficult to say whether legs are predominantly flexed or extended, as they extend up for a long time and then frog for a long time. Behavior is mostly bilateral. The shift from predominantly flexed to predominantly extended seems to come here (see Figure 1).

b. Foot behavior is much the same at 28 weeks.

c. Toes are predominantly in simple extension in all cases. Flexion occurs in 88 per cent of cases, Babinski in only 11 per cent; dorsal extension in 22 per cent.

d. Summary. Behavior resembles that at 28 weeks. Bilateral behavior predominates and legs are extended more than flexed.

9. *Thirty-Six Weeks (13 Cases)*

a. Legs are predominantly extended along the floor at this age (64%) though as at 32 weeks it is difficult to say for each child whether flexion or extension predominates, as legs are extended for long periods and then are flexed for long periods. Legs extend with feet straight (64%) or everted (50%). Legs extend upward, a prominent behavior at 28 and 32 weeks, has practically dropped out. Two flexor activities are frequently observed: legs flex (frog) upward with feet inverted (50%), or legs flex with feet in step position (46%). Foot to knee occurs less than at any preceding age (only 14%). Normative figures give 68 per cent rolling to one side and 38 per cent rolling to prone. Legs are almost continually bilateral. This is an extremely static age with little leg movement. Legs change from flexion to extension or vice versa but don't keep moving. Postures are held.

b. Feet are very versatile at this age, even though legs are not very active. As legs extend feet may be straight (64%) or everted

(50%). In only 18 per cent of the cases do legs extend with feet inverted. This is the first age since eight weeks that foot eversion predominates both as legs flex and as they extend. Foot inversion, however, predominates as legs flex upward. This is also the first age since eight weeks that feet are perpendicular to floor from heel to toe as legs extend, to an appreciable extent (25%). Feet assume step position as legs flex knees together (46%).

c. Toes are predominantly in simple extension in all cases. Flexion occurs in 58 per cent of cases; Babinski in 25 per cent; dorsal extension in only 16 per cent.

d. Summary. Bilateral extension predominates, legs on floor, feet straight or everted. There is little leg activity. Legs sometimes frog upward with feet inverted. Feet are very mobile. For the first time since eight weeks feet predominantly evert as legs flex and also as they extend. Toes extend.

10. *Forty Weeks (22 Cases)*

a. Legs. At this age few items occur in over 40 or 50 per cent of the cases. This may be due to the fact that the necessary growth trends have to some extent worked themselves out and infants are free to posture as they individually may. Supine is not, in many children, a favored position at this age. Normative figures give 58 per cent as rolling to prone or attaining sitting. At 40 weeks the trend toward predominant extension of legs is temporarily stayed. Only 50 per cent of the cases have legs predominantly extended; 50 per cent have them predominantly flexed. The two outstanding items are legs extend feet straight (45%), and legs flex knees together feet in step position (59%). For the first time since 16 weeks legs do not flex up from the floor to an appreciable extent.

b. Feet are in step position, straight, as legs flex with knees together in 59 per cent of the cases. Feet are also predominantly straight as legs extend (45%). This period of feet predominantly straight follows the earlier era of feet inverted, and precedes foot eversion which is predominant at 48 and 52 weeks. However, at this age there is more foot eversion than inversion. Thus legs extend feet everted 36 per cent, legs extend feet invert, only 22 per cent. Similarly legs flex feet evert, 22 per cent; legs flex feet invert or

soles oppose, only 4 per cent. As legs extend one foot may be planted one everted (31%).

c. Toes are predominantly in simple extension in all cases. Flexion occurs in 75 per cent of cases, Babinski in 25 per cent, dorsal extension in 8 per cent.

d. Summary. Legs extend on floor, feet straight; or flex with knees together and feet in step position. There are marked individual variations, and most infants roll to prone or attain sitting rather than remaining supine. This is the last flexor age. Feet are mostly straight. Toes extend.

11. *Forty-Four Weeks (14 cases)*

a. Legs are predominantly extended at this age in 71 per cent of the cases. Legs extend with feet everted (64%), and legs extend one foot straight one everted (43%). Two behaviors which have been previously conspicuous occur here for the last time: foot to knee (57%), and legs flex feet in step position (43%). At this age as at 40 weeks legs do not flex up from the floor. It will be noted that two unilateral behaviors are conspicuous here: foot to knee, and legs extend one foot planted one everted.

b. Feet evert as legs extend (64%) most important behavior at this age, though, as above, one foot may be straight, planted, and one everted (43%). Legs extend with feet straight only 14 per cent and legs extend feet inverted, only 7 per cent. Leg flexion is not important at this age, but when it occurs feet may be in step position (43%), everted (14%) or soles opposed (14%).

c. Toes are predominantly extended in all cases, though flexion occurs in 77 per cent of cases, Babinski in 33 per cent. No dorsal extension was observed. With no dorsal extension, and the last high peak for flexion, this seems to be a somewhat flexor period for toes.

d. Summary. Legs predominantly extend feet everted, or one planted one everted. Foot to knee and legs flex in step position occur for the last time. Unilateral behaviors (foot to knee, and one foot planted one everted) are conspicuous. Feet mostly evert. Toes extend though flexion occurs to a marked extent.

12. *Forty-Eight Weeks (13 Cases)*

a. Legs predominantly extend at this age (69%) and are little

active. Postures most frequently seen are: legs extend feet evert (46%); legs extend feet straight (46%); legs frog loosely, feet evert (46%). Bilateral behavior predominates.

b. Feet. Foot eversion predominates over foot inversion in both leg extension and leg flexion. At this age occurs the largest percentage (38%) of legs extend with feet perpendicular to floor, heel to toe.

c. Toes are predominantly in simple extension in all cases. Babinski occurs in 44 per cent of cases, flexion in 33 per cent; dorsal extension in 11 per cent.

d. Summary. Bilateral extension with feet everted or straight, or bilateral frogging with feet everted, are all equally predominant. Toes are in simple extension.

13. *Fifty-Two Weeks (14 Cases)*

a. Legs. For the first time legs are predominantly extended in 100 per cent of the cases. Most conspicuous behavior is legs extend feet evert (71 per cent of cases). Legs extend feet straight (43%) and legs extend one foot planted, straight, and one everted (also 43%). No flexor behaviors occur to an appreciable extent, the most frequent being legs frog feet evert, seen in only 28 per cent of the cases. Behavior is almost entirely bilateral and very static.

b. Feet evert predominantly whether legs flex or extend. Foot inversion seldom occurs.

c. Toes are predominantly in simple extension in all cases and very little other toe behavior is seen. Flexion occurs in only 16 per cent of cases; Babinski in 8 per cent, and dorsal extension in 8 per cent.

d. Summary. Legs predominantly extend in 100 per cent of the cases for the first time. Feet evert. Toes extend.

C. Tables, Graphs, and Illustrations

The percentages of cases at each age exhibiting each type of leg behavior are presented in Table 1. Starred items have been added from a previous study (3, p. 51). Table 2 shows the percentage of cases exhibiting each of the common kinds of toe behavior at each age.

These percentages have been graphed, and graphs for eight of the most frequently occurring behaviors are presented in Figures 1 and 2.

Age in weeks	4	8	12	16	20	24	28	32	36	40	44	48	52
Legs predominantly flexed	78%	36%	93%	93%	97%	91%	65%	27%	36%	50%	29%	30%	0%
Legs predominantly extended	21	63	7	7	3	9	34	72	64	50	71	69	100
Legs extend, feet evert	43	55	31	26	32	15	21	27	50	36	64	46	71
Legs extend, feet straight	28	39	28	19	27	9	38	20	64	45	14	46	43
Legs extend, feet invert	57	31	40	26	27	45	6	14	18	22	7	7	14
Legs extend, soles perpendicular to floor	14	28	4	6	9	15	3	14	25	13	21	38	0
Legs extend up, soles parallel floor	0	0	0	6	9	27	62	55	18	13	14	0	0
Legs extend up, soles oppose or invert	0	0	0	8	23	9	62	52	10	9	7	0	0
Legs extend to one side	0	0	0	13	35	9	24	27	14	4	7	0	14
Legs extend, one foot planted, one everted	0	0	2	0	3	0	0	13	23	31	43	30	43
Legs flex feet step position	0	18	62	80	65	51	45	41	46	59	43	15	21
Both flex, frog, feet evert	56	68	52	19	38	33	10	10	31	22	14	46	28
Both flex, frog, soles opposed or feet inverted, feet on floor	56	50	69	76	56	66	17	17	7	4	14	7	7
Both flex up, soles oppose toes up	21	8	28	41	47	42	86	55	50	9	14	15	0
Legs flex up, soles toward camera	43	42	57	52	65	24	24	17	25	18	21	7	0
One leg flexes and extends	100	71	26	6	44	12	21	10	7	22	7	7	7
Foot to knee	21	21	26	56	73	42	62	41	14	36	57	30	14
Normative percentages:													
Trunk rolls to side	39	29	12	50	59	62	54	54	68				
Rolls to prone	0	0	0	0	0	3	17	19	29	38	42		
Pivots	7	0	0	4	0	10	4						
Rolls or swings pelvis	35	57	58	32	21	7	8	8	4				

TABLE 2
TOE BEHAVIOR

Age in weeks	Predominant behavior patterns*: Babinski	Dorsal extension	Flexion	Plain extension	Observed behavior patterns: Babinski	Dorsal extension	Flexion	Plain extension
4	0%	33%	100%	0%	57%	100%	100%	16%
8	0	0	100	9	72	63	100	81
12	0	8	100	8	91	58	100	91
16	0	0	100	58	41	50	100	83
20	0	0	72	90	27	9	100	100
24	0	0	16	100	58	8	83	100
28	0	0	0	100	36	9	81	100
32	0	0	0	100	11	22	88	100
36	0	0	0	100	25	16	58	100
40	0	0	0	100	25	8	75	100
44	0	0	0	100	33	0	77	100
48	0	0	0	100	44	11	33	100
52	0	0	0	100	8	8	16	100

*At some ages two behaviors appear to be equally predominant.

These graphs illustrate decreasing, increasing, and recurrent items as well as behaviors which rise to a peak at about the sixth month and then decrease. They suggest the complexity of the factors which determine the behavior picture at any one age.

Behaviors which decline in importance include: *legs flex feet evert*,[3] legs predominantly flex, legs extend feet invert, *legs flex (frog) soles opposed,* legs flex up soles toward camera or everted, *one leg only flexes and extends,* and legs flex one foot planted, one everted.

Behaviors which follow a more normal curve include: legs extend up soles opposed, *legs extend up soles parallel to floor,* rolls to side only, *legs flex feet in step position, legs flex up soles opposed or inverted.*

Behaviors having increasing incidence with age are few: *legs predominantly extend,* legs extend one foot planted one everted, rolls to prone, legs extend feet straight.

[3]Percentages of occurrence for behaviors here in italics are given in Figures 1 and 2

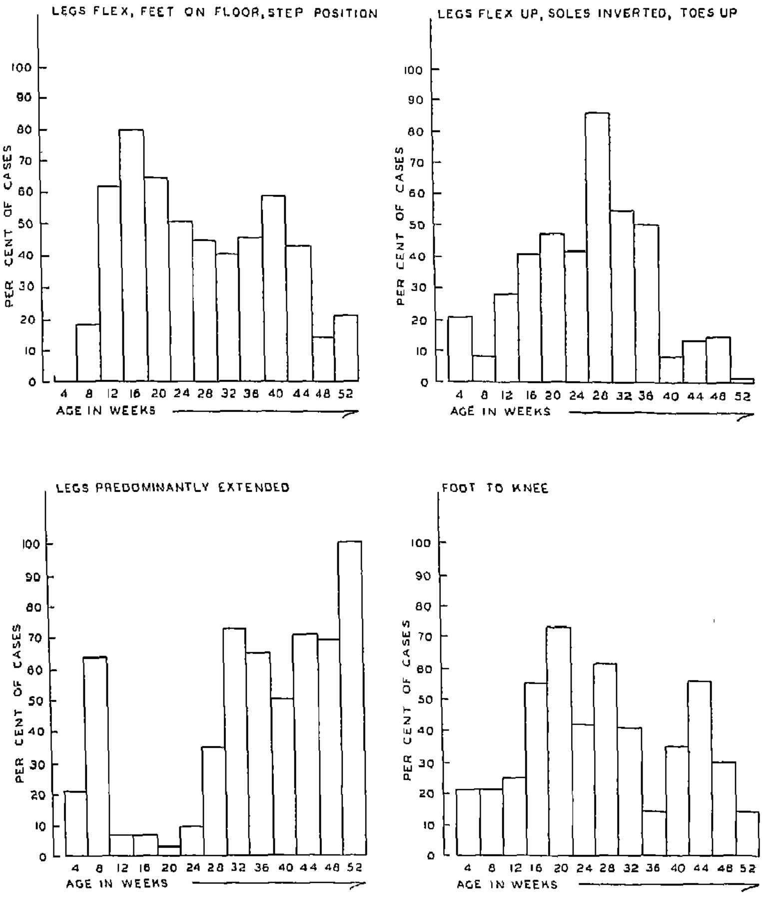

FIGURE 1
AGE CHANGES IN PERCENTAGE OF OCCURRENCE OF OUTSTANDING LEG BEHAVIORS AND POSTURES

Behaviors which recurrently reach or surpass the 50th percentile are: *foot to knee,* and legs extend feet everted.

Illustrations of the outstanding positions at each age (Figure 3) were obtained by selecting most typical cinema frames, projecting them onto paper by means of a special projection desk, and tracing. Outstanding leg behaviors for each age are illustrated, but not all behaviors for any age. Changes of posture, as rolling to prone or

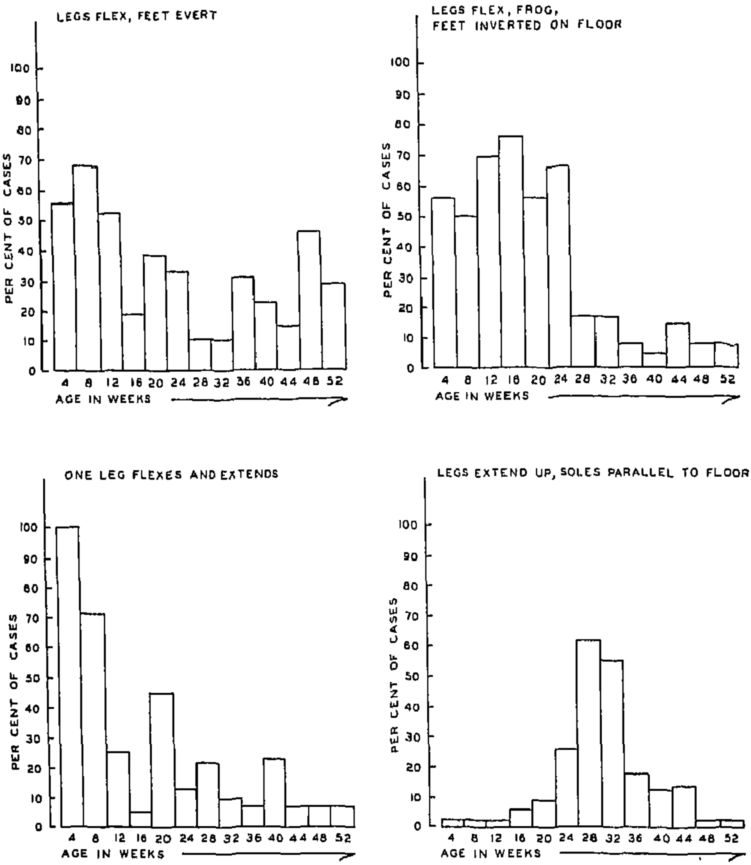

FIGURE 2
AGE CHANGES IN PERCENTAGE OF OCCURRENCE OF OUTSTANDING LEG BEHAVIORS AND POSTURES

attaining sitting are not illustrated' since they have been discussed fully in References 3, 4, and 5.

D. Comparison of Early and Late Behavior Pictures

Graphs in Figure 4, which give the per cent of cases exhibiting each type of behavior at each age in question, show how similar are the profiles for immediately succeeding ages, for example 12-16-20 weeks, and 44-48-52 weeks. They also indicate graphically the

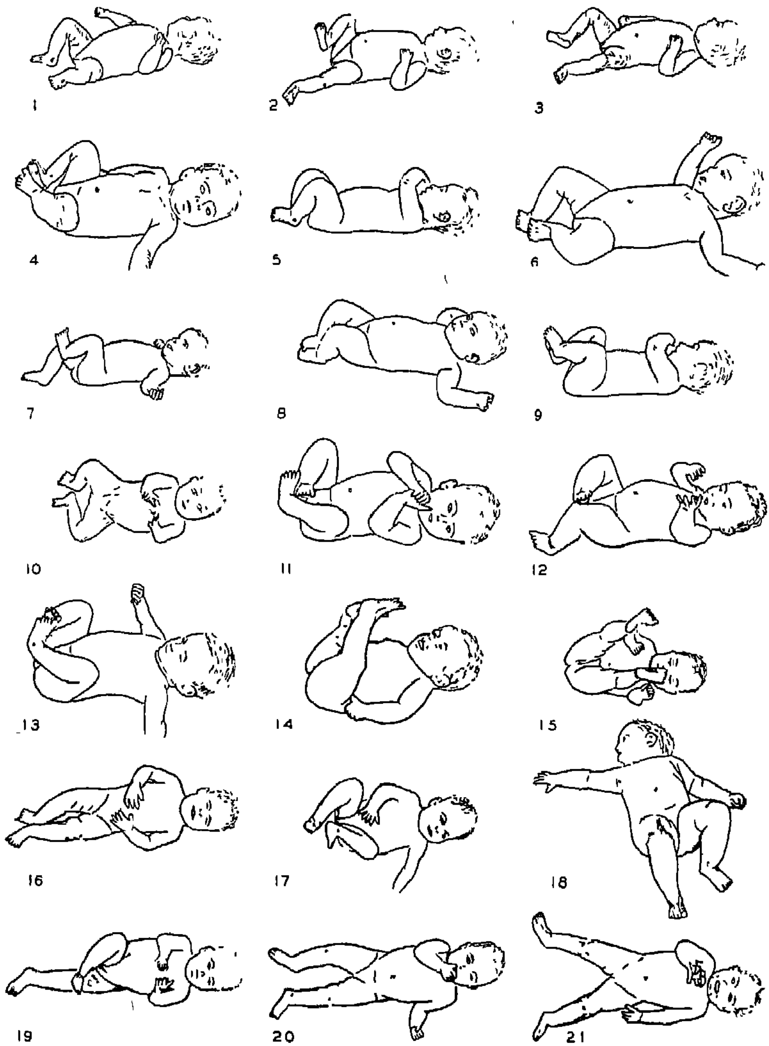

FIGURE 3

OUTSTANDING LEG BEHAVIORS FROM ONE WEEK TO ONE YEAR

1. Both legs flex feet everted (4-8 weeks).
2. Face leg flexes (4-8 weeks).
3. Face leg extends (4-8 weeks).
4. Legs flex soles opposed (12 weeks).
5. Legs flex feet in step position (12-16 weeks).
6. Legs flex, extension at hips, soles opposed (16 weeks).
7. Foot to knee (16-20 weeks).

8. Legs flex feet in step position (20 weeks).
9. Legs flex up toward trunk, knees together (20 weeks).
10. Legs "frog" soles opposed (24 weeks).
11. Legs frog up, feet invert (24 weeks).
12. Foot to knee (24-28 weeks).
13. Legs frog up soles opposed (28-32 weeks).
14. Legs extend up soles opposed (28-32 weeks).
15. Legs extend up soles parallel to floor (28-32 weeks).
16. Legs extend, feet straight (36 weeks).
17. Legs flex up soles opposed (36 weeks).
18. Legs flex feet in step position (40 weeks).
19. Foot to knee (44 weeks).
20. Legs extend feet evert (40-44 weeks).
21. Legs extend wide apart, feet evert (48-52 weeks).

marked difference between the supine behavior picture in the first and last quarters of the first year of life.

E. Summary: The Total Sequence

Four and eight weeks are much alike, though four weeks is more active and behavior seems more reflex. Legs at *four weeks* are predominantly in bilateral flexion or bilateral extension with feet inverted or everted. The chief activity is flexion and extension of one leg. At *eight weeks* there is more extension and more eversion of feet.

Twelve weeks. Unilateral behavior has dropped out and legs are bilaterally flexed. Legs are bilaterally flexed in outward rotation (frogged), feet everted or inverted; or as knees come together, feet assume a step position. *Sixteen weeks* is much the same, except that foot to knee becomes prominent. Though midline positions predominate, trunk may roll to the side as it did at four weeks. Legs are beginning to flex up from the platform. Legs assume many different postures at this age.

Twenty weeks is like 16, but there is more activity. Legs chiefly flex up from the platform, knees together. There is rolling to side and legs sometimes extend up. Foot to knee is still strong. Hips are active. Ankles are becoming mobile.

Twenty-four weeks, like 12 weeks, is chiefly an age of bilateral flexion with outward rotation (frogging), legs on or up from floor.

Twenty-eight and 32 weeks are much alike. Behavior is well patterned, legs go from one position to another easily. Thus they flex, feet in step position, frog up, extend up. Or foot goes to other knee. There is practically no frogging with feet on floor. Behavior

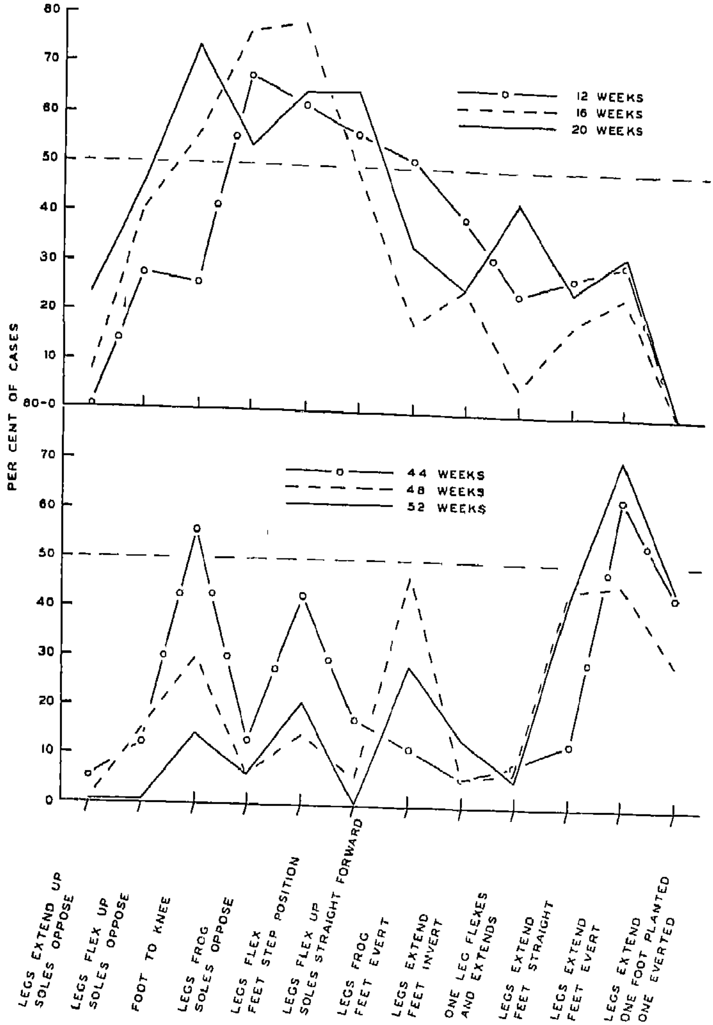

FIGURE 4
LEG BEHAVIORS OCCURRING AT 12-16-20 WEEKS COMPARED WITH THOSE FOR 44-48-52 WEEKS

is more bilateral at 32 than at 28 weeks. Feet are very mobile from this age on.

Thirty-six weeks. Now legs predominantly extend on floor, legs

close together, feet straight or everted. Also legs frog up feet inverted, or flex with feet in step position. Some rolling to side.

Forty weeks. Legs extend straight or more predominantly flex, feet in step position. This is the last flexor age. *Forty-four weeks.* Legs are predominantly extended, with both feet everted, or with one straight and one everted. Foot to knee and legs flex feet in step position both occur for the last time. Markedly unilateral behaviors are prominent for the last time.

Forty-eight weeks. Legs extend bilaterally, feet evert or straight, or frog bilaterally, feet everted. *Fifty-two weeks.* Legs are predominantly extended in 100 per cent of the cases, legs wide apart and feet everted.

In short, legs flex passively with passive flexion at hips and feet mostly inverted (4 weeks). Then more extension at hips causes a passive "frogging," knees apart (12 weeks). Knees come together, legs flexed, feet in step position (16 weeks); then both legs flex up toward trunk, knees together (20 weeks). Knees flex up toward trunk but in outward rotation, again causing "frogging" (24 weeks). Both legs extend up (28 weeks), then extend on floor close together (36 weeks). Lastly legs move apart, still in extension, feet markedly everted (52 weeks).

Asymmetric leg behavior occurs at intervals through this sequence, notably: one leg flexes and extends as other remains flexed (4 weeks) or extended (8 weeks). At 16, 20, and 28 weeks, and at 44 weeks, one leg is flexed, the other extended, bringing one foot to the opposite knee. At 44 and 52 weeks one leg may flex with foot in step position while other leg extends, foot everted.

Foot and toe behavior have been described in detail in the monthly age summaries. A brief résumé of foot behavior shows that feet may invert or evert at 4 weeks, evert at 8, invert 12-16 weeks. They are mobile at 20, mostly inverted at 24, and mobile and varied at 28 and 32 weeks. At 36 and 40 weeks they are straight; at 44 one is straight and planted, one everted. Both evert at 48-52 weeks.

The tabular summary of toe behavior (Table 2) shows that fewer kinds of behavior occur at any one age with increasing age, that there is less backward extension of toes, less Babinski, and less flexion (in that order) with increasing age; and more simple extension.

The general trend for legs and feet is from flexion and inversion

to extension and eversion. From much rapid activity to little activity. From feet passive and inverted to feet mobile and everted. From toes actively extending, flexing or exhibiting Babinski responses, to toes quiet in passive extension. From a number of different leg positions at any one age (six each at 4 and 8 weeks) to just a few positions (three each at 48 and 52 weeks).

References

1. Ames, L. B. The sequential patterning of prone progression in the human infant. *Genet. Psychol. Monog.*, 1937, **19**, 409-460.
2. Gesell, A., & Ames, L. B. The ontogenetic organization of prone behavior in human infancy. *J. Genet. Psychol.*, 1940, **56**, 247-263.
3. Gesell, A., & Tompson, H., assisted by Amatruda, C. S. Infant Behavior: Its Genesis and Growth. New York: McGraw Hill, 1934. Pp. viii+343.
4. ———. The Psychology of Early Growth Including Norms of Infant Behavior and a Method of Genetic Analysis. New York: Macmillan, 1938. Pp. ix+290.
5. Gesell, A., et al. An Atlas of Infant Behavior: A Systematic Delineation of the Forms and Early Growth of Human Behavior Patterns. New Haven: Yale Univ. Press, 1934. Pp. 922.
6. Wolff, L. V. The response to plantar stimulation in infancy. *Amer. J. Dis. Child.*, 1930, **39**, 1176-1185.

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CERTAIN SOCIAL INDICES IN THE LANGUAGE OF PRESCHOOL SUBJECTS*

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The term *social indices* is used in the present study to include the following types of language behavior: exclamatory words and syllables, non-exclamatory syllables, laughing, crying, and certain forms of affirmation and negation. The term is used by Fisher (6, p. 65) but she does not include exactly the same forms of expression as are listed in the present investigation. It is believed that the expressions just enumerated under the heading of *social indices* may yield valuable and interesting information concerning language growth and social development.

The study is based upon the language records of 74 preschool subjects 30 to 65 months of age. All were enrolled in the nursery school of The University of Georgia. The mean age was 47.6 months, and the subjects were divided into four groups, as follows: Regular boys, Relief boys, Regular girls, and Relief girls. Relief subjects came from homes where government relief was being received and all belonged to groups of inferior socio-economic status. Subjects designated as Regular cases came from relatively fortunate homes, from Groups I, II, or III of the occupational classification described by Goodenough and Anderson (7, p. 237). The four groups were of approximately the same age. Language records obtained during a total of 444 hours, or six hours for each of the 74 subjects, form the basis of this investigation. Since the records were secured in a nursery school the subjects usually were in situations with other preschool children present. The records were obtained while the subjects were at play, while eating, when looking at pictures, when engaged in routine procedures, and the like. More records were made during the free play periods outdoors than in any other setting. Detailed facts concerning subjects and procedures are given in another study by the writer (16).

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Exclamatory Words and Syllables

Although he regards the theory as inadequate, Jespersen (9, p. 414) gives the interjectional theory as to the origin of language, as follows: " . . . language is derived from instinctive ejaculations called forth by pain or other intense sensations or feelings." Since this theory is widely quoted it should be mentioned in connection with a study of exclamatory reactions.

In the present investigation all words and syllables which were emotionally-toned in a marked degree were included in the classification "exclamatory words and syllables." The only exceptions are the laughter and crying reactions which are given separately in terms of syllables in Table 1. The criteria as to what should constitute an exclamatory utterance vary somewhat from person to person. In the present investigation, ordinary requests and simple commands are not included with exclamatory words, for this category is reserved for those expressions which were distinguished by a pronounced degree of emotional tension, as far as the investigator was able to judge. The tone of voice, the facial expression, and frequently the overt bodily activities connected with aggression, submission, or retreat, were noted in deciding upon the classification.

From Table 1 it may be seen that exclamatory words have an incidence of 10.1 per hour per subject. Children of the upper socio-economic levels used more such words than Relief cases, the respective means being 12.2 and 7.9 words. Boys speak in exclamatory terms more than girls, the words per hour numbering 11.8 and 8.3, respectively. The greater incidence for the two groups, Regular subjects and boys, is due in large measure to the fact that Regular boys far surpass the other three groups in this type of expression. At all levels except that of 54 months Regular subjects have more exclamatory words than do Relief cases. Both groups of Regular subjects reach a peak at 48 months, after which there is a decline. Relief subjects are later in reaching their maximum and their largest record occurs at 54 months.

The groups 48 months, or more, of age employ more than twice the number of exclamatory words used by the younger subjects. It should be observed, however, that large differences occur within all age groups. While the pronounced increment at 48 months is, to a degree, a function of the increase in all vocalization it may be

TABLE 1

INCIDENCE PER HOUR OF EXCLAMATORY WORDS, EXCLAMATORY AND NON-EXCLAMATORY SYLLABLES, TOTAL SYLLABLES, LAUGHTER AND CRYING SYLLABLES, *Yes*, *No*, AND *Not*, FOR EACH SUBJECT

				Syllables							
CA	Group	Sex	Excl.* words	Excl *	Non-excl *	Total	Laugh.	Cry.	Yes	No	Not
30	Reg	M.	9.5	27.0	6.7	33.7	16.4	5 5	2.9	3.6	8.1
	Rel.	M.	3.5	11 4	6 7	18.1	8.9	9.0	2.3	3.1	6.1
	Reg.	F.	6.3	7.5	3.7	11.2	5.5	3.0	3.1	3.4	9.4
	Rel.	F.	5.2	4.3	2 6	6.9	2.6	2.8	2.5	1.7	5.2
	All		6.1	12.6	4.9	17.5	8.4	5.1	2.7	3.0	7.2
36	Reg	M.	7.3	13.0	11.1	24.1	9.2	2.0	4.5	4.2	7 8
	Rel.	M.	1.7	3 7	6.8	10.5	3.5	3.0	2.5	2 6	5.4
	Reg.	F.	3.1	7 0	3.9	10.9	2 4	2.6	3 2	3.7	8.5
	Rel.	F.	5.1	5.2	5.0	10.2	1.7	1.7	2 2	3.1	6.7
	All		4.3	7.2	6.7	13.9	4.2	2.3	3.1	3.4	7 1
42	Reg.	M.	10.3	15.2	9 9	25.1	5 6	1 3	3.5	3.3	9.1
	Rel.	M.	5.2	9 8	4.9	14.7	4.1	0.3	1.9	1.9	7.2
	Reg.	F.	7 5	4.0	8.2	12.2	4.5	0.0	2 7	2.8	9.5
	Rel	F.	6 7	1.5	5.3	6 8	2.3	0.3	2.3	1 7	10.1
	All		7.4	7.6	7 1	14.7	4.1	0.5	2 6	2.4	9.0
48	Reg.	M.	26.7	15 8	9.1	24.9	10.1	0 5	3.8	3.0	7.6
	Rel.	M.	5.7	10.8	6.1	16.9	3 5	0.6	2.8	2.2	5 5
	Reg	F	21 8	13.6	5 7	19.3	4.9	0.6	3.1	3.3	9.1
	Rel.	F	6.8	5.6	4.5	10 1	2 8	0.4	3 5	1.9	8.0
	All		15.3	11.5	6.4	17 8	5.3	0.5	3.3	2 6	7.6
54	Reg.	M.	16.8	13.7	19.5	33.2	13.6	0.4	4.0	3.3	9.6
	Rel.	M.	17.2	15.7	10.2	25 9	2.6	1.8	2.9	2 1	9.2
	Reg.	F.	8.6	10.2	5.4	15.6	2.8	0.0	3.9	2.8	8 3
	Rel.	F.	13.2	5.8	5.1	10.9	3.9	0 0	2.5	3 7	10 5
	All		14 0	11.4	10.1	21.4	5.7	0.6	3 3	3.0	9.4

TABLE 1 (*Continued*)

				Syllables								
CA	Group	Sex	Excl.* words	Excl *	Non-excl.*	Total	Laugh.	Cry.	Yes	No	Not
60	Reg.	M.	17.3	9.1	7.2	16 3	3.9	0.2	2.8	2.5	8 0
	Rel.	M.	19.4	5.1	5.5	10.6	1.5	0.3	1.7	2 1	9.5
	Reg.	F.	10.7	5.3	3 2	8.5	2 3	0.0	4.2	4.0	8.7
	Rel.	F.	4.1	3.8	4.6	8.4	0.0	0.0	2.1	1.4	9.2
	All		12 9	5.8	5.1	11 0	1.9	0.1	2.7	2.5	8.9
	Reg.	M.	14.7	15 6	10.6	26.2	9.8	1.7	3 6	3 3	8.4
	Rel.	M.	8 8	9.4	6.7	16.1	4.0	2.5	2.4	2.3	7.2
	Reg.	F.	9.7	7.9	5.0	13.0	3.7	1.0	3.3	3.3	8.9
	Rel.	F.	6.9	4.4	4.5	8.9	2.2	0.9	2 5	2.3	8.3
	All	M	11.8	12.5	8.7	21.2	6 9	2.1	3.0	2.8	7.8
	All	F	8.3	6.2	4.8	10.9	3.0	1.0	2.9	2.8	8.6
	Reg.		12.2	11.8	7.8	19.6	6.8	1.4	3 5	3.3	8.7
	Rel.		7.9	6 9	5.6	12.5	3.1	1 7	2 5	2 3	7.8
	All		10.1	9 4	6.7	16.1	5.0	1.6	3.0	2.8	8.3

*Abbreviations refer to *Exclamatory Words* and *Exclamatory* and *Non-Exclamatory* Syllables.

affected by the increasing tendency to use verbal expressions instead of physical combat when conflicts arise. The results are of particular interest since several previous investigations have reported conflicting data as to age trends. Some observed a marked decrease and others a marked increase with age.

McCarthy (12, p. 78), who included wishes, requests, commands, and the like, in the classification of emotionally-toned responses found a decrease with age in such responses. As in the present study, such expressions were more used by boys than by girls. Smith (14, p. 192) likewise observed that imperatives decreased from 18 per cent at 30 months to 14 per cent at 66 months. On the other hand, Fisher (6, p. 41) found a rapid increase in commands with age and girls tended to give more commands than boys.

Closely related to the use of exclamatory words is the problem of exclamatory syllables, a term arbitrarily used to include all vocal expressions not listed as comprehensible words which were uttered with a pronounced degree of emotional feeling. An exception occurs with laughter and crying which are classified separately in Table 1.

Exclamatory syllables are almost as numerous as exclamatory words, the frequency per subject being 9.4 syllables per hour, as compared with 10.1 exclamatory words in that period of time. Again, Regular subjects and boys have many more such syllables than the contrasting groups, the larger incidence being due primarily to the leadership of Regular boys in the use of this type of vocalization. The subjects at 36, 42, and 60 months of age have few such syllables when compared with those of other age levels. It will be observed that the mean for exclamatory syllables at 30 months is approximately twice as large as the mean for exclamatory words, and syllables still predominate at 36 months. Apparently, the two youngest groups of subjects tend to resort to relatively unstandardized syllables rather than standard types of speech in the form of words, when emotionally aroused. At 42 months words and syllables have approximately the same frequencies. At 48 months, and thereafter, the use of words surpasses the use of syllables when verbal expressions of emotions occur. Seemingly the mastery of words has progressed far enough by the age of four years to result in the dominance of comprehensible words as the main form of expression even when the subjects are in a state of emotional tension. Although exclamatory words are more

numerous than exclamatory syllables from 48 to 65 months, syllables have larger frequencies at 48 and 54 months than at previous ages. This may be, in part, a function of the increase in verbal behavior with age, and it may be a reflection of the tendency in older subjects to use vocal expressions rather than physical combat when conflicts arise. Shouts, squeals, and grunts are the most frequently recorded types of exclamatory syllables.

Non-Exclamatory Syllables

Jespersen (9, p. 148) noted that children often "played at language." He said of this type of behavior that "the child takes delight in making meaningless sounds long after it has learnt the language of its elders." He pointed out the apparent pleasure of children in varying the sounds of words and introducing, for instance, alliterations, and their liking for rhythm, rime, and onomatopoeia. G. Stanley Hall (8) also noticed that "Pleasure was often found in making all possible noises with variations of pitch, stress, etc., but whether for ears, voice, or both, none can say."

In connection with the tendency which has just been described it is important to mention Jespersen's (9, p. 433) views concerning the origin of language. He stated that "Language originated as play, and the organs of speech were first trained in this singing sport of idle hours." He (9, p. 441) further wrote that "Language, then, began with half-musical, unanalyzed expressions for individual beings and solitary events." He (9, p. 437) pointed out that "It is perfectly possible that speech has developed from something which had no other purpose than that of exercising the muscles of the mouth and throat and of amusing oneself and others by the production of pleasant or possibly only strange sounds." Consideration of the statements just quoted would indicate the special significance of non-exclamatory syllables.

The subjects used an average of 6.7 such syllables an hour in making sounds which apparently had little or no emotional significance. Again, Regular subjects and boys had the largest frequencies, due primarily to the influence of the records of Regular boys. The highest incidence occurred at 54 months. Especially in the older subjects relatively large numbers of non-exclamatory syllables were related to dramatic play. At no age level, however, were more than

65 per cent of the utterances imitative of animals, trains, automobiles, and the like. There was a marked inclination on the part of the subjects to make a vocalization of the non-exclamatory type and then repeat it again and again, with occasional variations. In numerous instances sounds of non-exclamatory type were heard when the subjects were using vehicular toys, running, swinging, and the like. There was a pronounced tendency for vocal activity to accompany these and other forms of physical activity. In many cases when the non-exclamatory vocalizations were heard the subject was engaged in what may be described as parallel play and the language patterns were affected by the meaningful or meaningless sounds made by a colleague. It appeared that the subjects enjoyed the making of sounds and the use of the speech mechanism, and at times the communication of thought seemed to be unrelated to the vocalizations which occurred.

Total Syllables

Exclamatory syllables are somewhat more numerous than non-exclamatory syllables, the respective figures being 9.4 and 6.7. The superiority is most pronounced at the ages of 30 and 48 months.

The incidence of the total number of syllables, exclamatory and non-exclamatory, shows a decrease at 36 months followed by a rise to a peak at 54 months. As previously mentioned, the increase with age may be regarded as, in part, a function of the increasing tendency to vocalize.

Boys used nearly twice as many syllables as girls, both groups of boys markedly surpassing the two groups of girls. These facts are of particular interest inasmuch as girls were found to be significantly superior to boys in amount of comprehensible behavior, that is, in the number of words spoken, in the major study by the writer (16). The superiority of girls in the use of words, the accepted form of speech, as contrasted with the leadership of boys in the use of syllables, which are relatively unstandardized forms of expression, may indicate that a higher level of maturation had been reached by girls. It should be noted, however, that Regular subjects markedly surpassed Relief cases in the incidence of syllables, and Regular subjects likewise were significantly superior when compared with Relief cases as to amount of comprehensible verbal behavior (16).

In some studies of language development syllables, which constitute

relatively unstandardized language, are combined with comprehensible words. It is admittedly difficult at times to discover the line of demarcation. However, it appears from the present study that an effort should be made to separate the two types of language reactions. From certain comparisons of the comprehensible speech of age, sex, and socio-economic groups the writer (16) has obtained results which are quite different from those secured in the present study from comparisons of the syllables (Table 1) used by these groups. Since the findings differ, in the sense that the relationships of the compared groups are not the same, it seems advisable to tabulate separately the comprehensible speech and the syllables, as these terms are used in the present study.

LAUGHTER

Bird (2) observed laughter of kindergarten children and concluded that it was not a social gesture but an individual expression of defense against some unusual condition which threatened to submerge thought and cause mental confusion. Laughter was, therefore, an attempt at adjustment. Blatz, Allin, and Millichamp (3) indicated, from a study of 90 subjects, that laughter appeared at the resolution of a dilemma which had confronted the individual. Brackett (4, p. 82) found, from a study of 29 preschool children, that laughter was highly social, since the subjects laughed most when in association with others. Boys and girls showed more laughter when associating with their own sex. Much more laughter occurred during free play than during routine activities. Jones (10, p. 291) listed 85 specific situations in which laughter occurred for preschool cases. The three most effective causes were: (*a*) those related to a feeling of well-being; (*b*) exciting physical contacts; and, (*c*) situations which provided an opportunity for self-assertion.

In the present study no attempt has been made to analyze the causes which apparently operated to produce laughter. Emphasis will be placed upon the incidence of laughter and upon certain group comparisons. The frequency of smiling is not included in this investigation.

In Table 1 it may be observed that 5.0 laughter syllables per hour occurred for each subject. In this connection it is of interest to note that Arrington (1, p. 38) reported that laughter was recorded in only

274 out of a possible 9000 five-second intervals. Brackett (4, p. 72) noted that the subjects laughed only 6.7 per cent of the time they were observed.

In the present study the children 30 months of age laughed most, with an average of 8.4 syllables an hour per subject. The superiority of the youngest cases is in accordance with the findings of Kenderdine (11). Brackett (4, p. 82), however, obtained a correlation of $.44 \pm .10$ between age and incidence of laughter.

Regular boys markedly surpassed Relief boys, and Regular girls excelled Relief girls in the number of laughter syllables. Regular boys displayed more than twice as much merriment as any other group. Regular subjects laughed more than twice as often as Relief cases. That the difference is not simply a function of socio-economic status is evidenced by the fact that Relief boys slightly surpass Regular girls. Relief boys also have many more laughter syllables than do Relief girls. Boys of both socio-economic groups markedly excel the girls of their respective groups, and sex differences, therefore, are especially noteworthy. It will be recalled that similar sex differences resulted (Table 1) from the comparisons of exclamatory and non-exclamatory syllables, both when separate and combined.

Crying

According to the findings of Jones reported by Watson (15, p. 140), children cry when tired, hungry, are interfered with in some activity, or when frightened, and the like. Jones (10, p. 290) stated that Bridges attributed crying in nursery school chiefly to distress and discomfort or, in the case of newly enrolled children, to the lost sense of security. Brackett (4, p. 90) found that crying was predominately social, although to a less degree than laughter. The crying of boys tended to be associated with their own sex, and the crying of girls was largely associated with boys. Crying decreased markedly in routine situations in contrast with activity during free play.

In the present study no attempt has been made to analyze the causes of crying. Emphasis will be placed upon the incidence of syllables uttered in crying and upon certain group comparisons. It should be stated that the major purpose of the language investigation (16) was to obtain records of the speech of the subjects, hence no record was begun if the child happened to be crying. If crying

occurred during the recording an intermission was taken after 40 seconds of crying had been noted. The fact should be emphasized that the record in Table 1 includes only the crying which occurred under the conditions just described.

The mean number of syllables per subject uttered in crying was 1.6 per hour. Brackett (4, p. 90) also reported relatively little crying, since the subjects cried only 2.5 per cent of the time they were observed, or less than half as much as they laughed. In the present study the children laughed more than three times as much as they cried, but the limitation of crying records to 40 seconds somewhat reduced the incidence of this type of reaction.

There is a consistent decrease in crying with age, the greatest rate of decrease being indicated by the respective means of 5.1 and 0.5 at 30 and 42 months. Caille (5, p. 97) likewise reported that crying decreased with age. These facts are in accordance with Brackett's (4, p. 90) correlation of $-.47 \pm .10$ between the frequency of crying and age. The marked decrease in crying may be taken as a possible indication of greater self-control and a more mature type of adjustment on the part of the older subjects. Apparently they had found methods of getting along with their colleagues which involved relatively small amounts of this type of reaction.

Boys cried approximately twice as much as girls. Both groups of boys cried far more than did the groups of girls. This is in accordance with previously stated facts concerning the leadership of boys in the several forms of vocalization which have been recorded in Table 1 in terms of syllables. Relief boys had by far the largest incidence of this type of behavior. The fact that boys markedly surpassed girls in amount of crying is of particular interest since such behavior usually is considered to be more characteristic of the female sex.

Relief subjects cried more than Regular subjects, the respective means being 1.7 and 1.4 syllables. Relief girls, however, cried less than the children of the other three groups. The relatively large record of Relief cases, therefore, is due to the fact that Relief boys had the greatest numbers of syllables. Crying usually is considered as a type of infantile behavior and the fact that this reaction occurred more frequently in boys may be regarded as possible evidence that girls had reached a higher level of maturation. It is likewise possible that the greater use by girls of standard speech in the form of words,

as reported by the writer (16), made it less necessary for them to resort to crying.

The crying of many of the younger subjects was related to the attempts of older children to take some possession, or to the actual or feared injury which was associated with older subjects. This seemed to be more characteristic of Relief boys than of the other three groups, although a careful study of causes was not attempted.

AFFIRMATION

In the present study the forms of affirmation are limited to the use of *yes* and common substitutes for this word, as follows: *uh-huh, yeah, yep, yeth,* and *yeh.* Although adults tend to regard acquiescence in young children as highly desirable, relatively few studies have been made of these types of positive reactions. Far more attention has been given to negative responses. Since the language observations for the data in the present investigation were made in a nursery school most of the responses were directed to other children rather than to adults. Ostensibly, such positive reactions may be a helpful indication of social adjustment.

The forms of agreement recorded in this study occurred with an incidence of 3.0 responses an hour per child. There is some change in the frequencies with age, the range of the means being from 2.6 to 3.3. at the several age levels. The peaks occur at 48 and 54 months of age for the entire group of subjects. The ages at which the greatest acquiescence was noted, as indicated by the use of *yes* or its substitutes, vary from group to group, as follows: Regular boys, at 36 months; Relief boys, at 54 months; Regular girls, at 60 months; and Relief girls at 48 months. It should be observed that in some instances secondary peaks are almost as large as those at the ages just indicated. The failure to find consistent, marked age trends is in keeping with the report of Caille (5, p. 122) who, in a study of 36 preschool children, found no significant relationship between age and acquiescence. However, Smith (14, p. 190) noted a decrease with age in the percentage of sentences classified as being of the *yes* type.

Expressions of agreement (Table 1) are used much more by Regular than Relief cases, and the respective means are 3.5 and 2.5 words per subject per hour. Regular boys surpass all subjects, but in comparison with Regular girls the difference is small. Relief

boys and Relief girls also have records which are very similar. Boys surpass girls but the difference is negligible. This is in accordance with the statement of Caille (5, p. 122), who found only a slight difference in favor of boys.

Negation

In the present study no attempt has been made to differentiate between *no* which signified refusal and probably had an affective tone, and *no* as a simple statement of fact. However, the emotionally-toned use of *no* has been included in the exclamatory words found in Table 1 when its use reached the criteria set for these expressions. No methods of indicating negation except the incidence of *no* and *not*, and their common substitutes, are included in this investigation.

The use of *no* reached a peak at 36 months, with secondary peaks at 30 and 54 months. The range of the means at the several age levels is from 2.4 to 3.4. The periods of greatest use occur at different ages, as follows: Regular boys, at 36 months; Relief boys, at 30 months; Regular girls, at 60 months; and Relief girls, at 54 months. The fact that a clear-cut age trend is not observed is contrary to the findings of Reynolds (13, p. 120) and Smith (14, p. 190). They reported, respectively, that negativistic scores and sentences classified as *no* types decreased with age. Caille (5, p. 122), however, in agreement with the present study, found no significant relationship between age and language resistance.

Regular subjects used *no* much more than Relief cases, the respective means being 3.3 and 2.3. No differences resulted from comparisons of Regular boys and Regular girls, of Relief boys and Relief girls, or of boys and girls. These facts are of particular interest since the differences were statistically significant, or closely approached significance, when these same groups were compared as to amount of language used (16). In this connection it should be stated that Reynolds (13, p. 120) and Fisher (6, p. 68) likewise obtained no evidence of consistent sex differences in the forms of negation which they studied.

The use of *not* and *n't* occurs in the present investigation approximately three times as often as *no*, or 8.3 times per hour per subject. The largest frequencies are recorded at 54, 42, and 60 months. The range of means for all ages, however, is only 7.1 to

9.4. The ages of greatest frequency vary for the several groups, as follows: Regular boys, at 54 months; Relief boys, at 60 months; Regular girls, at 42 months; and Relief girls, at 54 months. For all groups there are relatively large secondary peaks and no consistent, marked increase or decrease with age is observable. In this connection should be mentioned the report of Smith (14, p. 190), who found an increase with age in negative sentences from 10 to 14 per cent, and the report of Fisher (6, p. 70), who obtained a correlation of $.71 \pm .04$ between the percentage of total sentences stated in the negative and age.

Girls somewhat surpass boys in use of *not,* the respective means being 8.6 and 7.8. The incidence is greatest for Regular girls and least for Relief boys. Regular subjects excel those of inferior socio-economic status but the difference is not great.

Summary

1. Exclamatory words have an incidence of 10.1 per hour per subject. Children of the upper socio-economic levels and boys markedly surpassed the contrasting groups in use of such terms. The frequency above the age of 47 months is more than twice the occurrence prior to that level.

2. Exclamatory syllables are almost as numerous as exclamatory words. Subjects of more fortunate socio-economic background and boys used many more such expressions than did subjects of the contrasting groups. The youngest subjects used twice as many exclamatory syllables as exclamatory words when emotionally aroused, but with increase in age exclamatory words predominated.

3. The subjects of the present study used 6.7 non-exclamatory syllables per hour per individual. Such vocalization occurred more frequently for Regular cases and boys than for other subjects. The highest incidence for the combined groups is at 54 months of age. Many non-exclamatory syllables were related to dramatic play while others appeared to be motivated primarily by the pleasure derived from use of the speech mechanism.

4. Exclamatory syllables are somewhat more numerous than non-exclamatory syllables. Boys used nearly twice as many syllables (exclamatory and non-exclamatory) as girls, although in a previous investigation (16) involving the same subjects girls were found to be

significantly superior to boys in number of comprehensible words spoken. Inasmuch as the relationships of groups were found to differ markedly when compared as to the incidence of words and syllables, it seems advisable to tabulate separately these forms of expression.

5. Laughter syllables have an incidence per subject of 5.0 an hour. Boys displayed far more merriment than girls, and boys of the upper socio-economic levels markedly excelled all other subjects. Relief boys slightly surpassed Regular girls in number of laughter syllables, indicating that the superiority of Regular subjects in this respect was not entirely due to socio-economic factors. The youngest subjects laughed much more than any others.

6. The mean number of syllables per subject uttered in crying was 1.6 per hour. A marked decrease in crying occurred with age. Boys cried approximately twice as much as girls, and Relief boys had by far the largest incidence of this type of behavior.

7. The use of *yes* and *no*, with their substitutes, occurred with respective frequencies of 3.0 and 2.8 responses an hour per child. The ages at which the largest numbers are found vary from group to group, and no consistent age trend is noted. Regular subjects markedly surpassed Relief cases, but sex differences were absent or negligible.

8. *Not* and *n't* were used 8.3 times per hour per subject. The ages of greatest incidence vary from group to group, and no consistent age trend is observable. Regular subjects and girls somewhat surpassed the contrasting groups in use of these terms.

References

1. Arrington, R. E. Interrelations in the behavior of young children. *Teach Coll. Child Devel. Monog.*, 1932, No. 8. Pp. xviii+156.
2. Bird, G. E The laughter of kindergarten children. *Psychol. Bull.*, 1936, **33**, 763.
3. Blatz, W. E., Allin, K. D., & Millichamp, D A. A study of laughter in the nursery school child. *Univ. Toronto Stud. Child Devel. Ser.*, 1936, **7**. Pp. 31.
4. Brackett, C. W. Laughing and crying of preschool children *Teach. Coll Child. Devel. Monog*, 1934, **14** Pp. vx+91.
5. Caille, R. K. Resistant behavior of preschool children *Teach. Coll. Child Devel. Monog.*, 1933, **11**. Pp. xv+142.
6. Fisher, M. S. Language patterns of preschool children. *Teach. Coll. Child Devel. Monog.*, 1934, **15**. Pp. xvl+88.

7. GOODENOUGH, F L., & ANDERSON, J. E. Experimental Child Study. New York: Century, 1931. Pp. xii+546.

8. HALL, G. S. Notes on the study of infants. *Ped. Sem.*, 1891, **1**, 127-138.

9. JESPERSEN, O. Language, Its Nature, Development and Origin. London: Allen & Unwin, 1922. Pp. 448.

10. JONES, M. C. Emotional development. In *A Handbook of child psychology*, 2nd. ed, ed. by C Murchison. Worcester, Mass.: Clark Univ. Press, 1933. Pp. 271-302.

11. KENDERDINE, M. Laughter in the preschool child. *Child Devel.*, 1931, **2**, 228-230.

12 McCARTHY, D. The language development of the preschool child. *Univ. Minn. Inst. Child Welf. Monog. Ser.*, 1930, **4**. Pp. xiii+174.

13. REYNOLDS, M. M. Negativism of pre-school children. *Teach. Coll. Contrib. Educ.*, 1928, **288**. Pp. viii+126.

14. SMITH, M. E. A study of some factors influencing the development of the sentence in preschool children. *J. Genet. Psychol.*, 1935, **46**, 182-212.

15. WATSON, J B Behaviorism. New York: Norton, 1925. Pp. 251

16. YOUNG, F M. An analysis of certain variables in a developmental study of language. *Genet. Psychol Monog.*, 1941, **23**, 3-141.

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DEVELOPMENT AS INDICATED BY A STUDY OF PRONOUNS*

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Jespersen (6, p. 68), in speaking of pronouns, said "The importance of these words in speech and grammar is enormous." Boyd (1, p. 119) ascribed significance to the incidence of certain pronouns, as follows: "The diminishing of the *I* and the growing use of the other pronouns, especially of the *we* and *you*, is a significant revelation of the process by which the self-centered child is transformed into a social being." Markey (8, p. 98) likewise referred to this developmental process and noted that "symbolic behavior becomes concerned with other persons and objects to a greater and greater degree" as the subjects become older. Drever (3, p. 186) observed that "there are in the child's vocabulary definite marks of definite stages of mental development. One such mark is the first personal pronoun."

Since pronouns are regarded as important indices of development and relatively few studies are available, the results of the present investigation are presented. It is based upon the language used by 74 preschool children during 444 hours of observation. All were enrolled in the nursery school of The University of Georgia. Approximately half the records were obtained when the subjects were engaged in free play outdoors, and the remaining records were secured during indoor play, during routine procedures, while eating, or while looking at pictures, and the like. The subjects ranged in age from 30 to 65 months, the mean age being 47.6 months. The children were divided into four groups of approximately the same age and the groups were designated as Regular boys, Regular girls, Relief boys, and Relief girls. Relief subjects came from homes which were being aided by government relief, and all were from environments of relatively poor socio-economic classification. Regular subjects were representative of more fortunate homes, and the paternal

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occupations were in Groups I, II, or III, according to the categories given by Goodenough and Anderson (5, p. 237).

In the present study, Jespersen's *Essentials of English Grammar* (6) has been used as the basis of classification, although certain references have been made to Jespersen's other works. It is important to note the writer whose works constituted the basis of this investigation since authorities on grammar do not always agree. Further details concerning subjects and procedures may be obtained from a study of language development by the writer (9).

In the major study (9) it was found that pronouns, including all types, constituted approximately 28 per cent of the comprehensible words spoken. The proportions did not change greatly between the ages of 30 and 65 months, and the differences between the sexes and between socio-economic groups were relatively small.

In the discussion which follows only personal and possessive pronouns are included inasmuch as they appear to give valuable information concerning the language development of the young child. In addition to noting which pronouns predominate, sex, age, and socio-economic differences will be observed.

In Table 1 may be found the ratio of specific pronouns to the total number of personal and possessive pronouns by age and sex for Regular and Relief subjects. Pronouns of the first person singular number account for the largest proportion of personal pronouns, 36 and 39 per cent, for Regular and Relief subjects, respectively. The subjects used the pronouns *I, me,* and *myself* more than all others (excluding *it*) combined. *Other* pronouns (excluding *it*) constituted 32 and 30 per cent of the total number of personal and possessive pronouns used by Regular and Relief cases. However, the addition of *it,* which has a record of 19 per cent, brings the total to approximately 50 per cent. This, perhaps, may be interpreted to mean that the subjects were not as egocentric as they at first appeared to be. They referred more often to other persons, or to things and situations, than to themselves as specific individuals, as shown by the ratios of 50 and 38 per cent.

The subjects in this investigation apparently were somewhat more affected by the "face-to-face" relationship indicated by the use of *you,* than by the relationship evidenced by pronouns of the third person (excluding *it*). Personal pronouns of the second and third

TABLE 1

RATIO OF SPECIFIC PRONOUNS* TO TOTAL NUMBER OF PERSONAL AND POSSESSIVE PRONOUNS BY AGE, GROUP, AND SEX

Pronoun		I-Me		We-Us		You		He-She They		It		One Body		Total Other		Possess.	
Person		First		First		Second		Third		Third		Third		All		All	
Number		Sing.		Plu.		All		All		Sing.		Sing		All		All	
C.A.	Sex	Reg.	Rel.	Reg.	Rel.	Reg.	Rel.	Reg.	Rel	Reg.	Rel.	Reg.	Rel.	Reg.	Rel	Reg.	Rel.
30	M.	36	38	2	0	8	9	10	10	29	28	2	0	22	22	12	13
	F.	23	43	4	2	9	9	10	7	25	23	2	2	25	20	27	15
	All	30	41	3	1	9	9	10	9	27	26	2	1	24	22	20	14
36	M.	33	43	4	1	15	10	9	7	24	24	2	1	30	19	13	12
	F.	46	39	2	2	15	11	5	7	13	23	3	2	25	22	17	16
	All	40	41	3	2	15	11	7	7	19	24	3	2	28	21	15	14
42	M.	34	37	7	3	13	13	8	10	23	19	4	4	32	30	10	13
	F.	41	43	5	2	19	18	7	8	13	9	3	3	34	31	12	16
	All	38	40	6	3	16	16	8	9	18	14	4	4	33	31	11	15
48	M.	34	34	5	3	16	15	10	13	19	17	4	4	35	35	11	15
	F.	36	39	6	5	15	13	11	8	16	17	3	4	35	30	13	13
	All	35	37	6	4	16	14	11	11	18	17	4	4	35	33	12	14
54	M.	34	35	7	3	17	20	7	8	18	19	3	4	34	35	14	10
	F.	35	38	8	6	23	19	7	9	13	14	2	3	40	37	12	12
	All	35	37	8	5	20	20	7	9	16	17	3	4	37	36	13	11
60	M.	41	36	4	7	19	22	8	9	14	17	4	2	35	40	11	7
	F.	39	41	5	4	18	16	9	10	15	11	2	5	34	35	12	14
	All	40	39	5	6	19	19	9	10	15	14	3	4	35	38	12	11
All	M.	35	37	5	3	15	15	8	10	21	21	3	3	32	30	12	12
	F.	37	41	5	4	17	14	8	8	16	16	3	3	32	29	16	14
	All	36	39	5	4	16	15	8	9	19	19	3	3	32	30	14	13

*Reflexive pronouns are included in their proper groups, as, *myself* is included with the group of the first person singular number. The third person also includes *him, her, they,* and *them.* The group of *one* and *body* pronouns includes such pronouns as *anyone* and *somebody.* *Other* pronouns refer to persons other than the self. In the total *other* group are the *we, you, he,* and *one* columns.

persons constitute 16 and 12 per cent of the total number involved (Table 1). In this connection it should be stated that approximately 18 children were enrolled each quarter and the subjects had ample opportunity for reference to many persons. This point is stated since in some previous investigations of language development the subject was alone with the experimenter and this might tend to produce a larger proportion of pronouns of the second person than was found in the present study.

Although the children had available many playmates they seldom spoke in terms of "we" or "us." Only about 5 per cent of the pronouns are recorded in this classification. Probably there were many reasons why the subjects did not speak of themselves frequently as members of a group. It is possible that it is easier for a young child to understand that he is a self in contrast to other selves, than to comprehend that he is a member of a group which is composed of several selves, especially when the composition of a group changes with relative frequency, as is usually the case at the preschool level. According to the views of many writers these subjects evidenced only a small degree of socialization, as judged by their use of *we* and *us*. It should be noted, however, that the incidence of personal pronouns is not regarded by all observers as a fair index of the growth of social consciousness. Low (7, p. 35), for instance, states that the higher incidence of *I* in a subject's record does not warrant the belief of a "better-developed ego-consciousness."

Certain changes in the percentages of pronouns are concomitant with increase in age (Table 1). In this connection it should be stated that the *ego* pronouns have smaller percentages than would be expected at 30 months because of the frequency of ellipsis in the language of young children. The first personal pronouns were often omitted and in the present investigation no words are included unless actually used by the subjects. Another factor of importance is the tendency of some young subjects to call themselves by their own names instead of using pronouns. This was especially noticeable in several of the Regular girls in the youngest group. If *self* pronouns had been supplied where they should have been used, the proportions of *ego* pronouns, especially at 30 months, would have been larger. *Ego* pronouns show a slight increase from 36 per cent at 30 months to 40 per cent at 60 months. *Other* pronouns, those re-

ferring to other persons (excluding *it*), increase by 14 per cent at these age levels.

An increase with age may be noted from the comparison of *we-us*. These pronouns constitute only 2 per cent at 30 months but make up 6.5 per cent at 54 months (Table 1). This is in accord with the finding of Fisher (4, p. 72) who obtained a correlation of .72±.04 between the use of *we, us,* and *our,* and chronological age.

In the present study, pronouns of the second person likewise increase with age, and the proportion at 54 months is more than double that at 30 months, a possible evidence of the increasing recognition of others.

Pronouns of the third person, such as *he, she,* and *they,* have their largest percentages at 30, 48, and 60 months, and the changes concurrent with age are not consistent. The use of *it* decreases with age, from 27 per cent at 30 months to 15 per cent at 60 months. Emphasis should be placed upon the fact that this decrease is compensated for by the increase in *other* (excluding *it*) pronouns (Table 1). The subjects in the present investigation do not become less egocentric with age, as adjudged by their use of *I, me,* and *myself,* but the older subjects tend to talk less about objects and conditions, a practice which involves the use of *it,* and more about and to other people, a practice which involves the use of *other* (excluding *it*) pronouns.

In this connection it is of interest to observe that Fisher (4, p. 19) found no increase after 24 months in the amount of time a child talked about himself. She indicated that the percentage of total remarks about other people increased with age up to the fourth year and then remained fairly constant. Boyd (1, p. 119) and Markey (8, p. 98), however, reported an increase in *other* pronouns with age, as found in the present study. They, and also Davis (2, p. 117), disagree with the findings of the present investigation in that they found decreases in the *self* references with age.

Do girls have a more rapid rate of social development as indicated by their use of personal pronouns? Fisher (4, p. 72) thus interpreted her finding that girls somewhat excelled in the use of *we, us,* and *our* until the 54 months age level. In the present investigation no consistent sex differences occur in respect to these pronouns, inasmuch as girls lead at three age levels and boys lead at 36, 42, and

60 months. Girls use *I, me,* and *myself* slightly more than boys, but the difference is only 3 per cent. At the early age levels, however, rather marked sex differences occur in the proportions of the *ego* pronouns, especially as a result of comparing Regular girls and Regular boys. When the sexes are compared as to their use of *other* pronouns (excluding *it*) the two groups have almost the same averages. The largest sex difference noted in Table 1 occurs in the use of *it,* for which part of speech boys and girls have records of 21 and 16 per cent, respectively. In general, the sex differences in pronoun usage, as observed in the present study, are relatively small.

Comparisons of socio-economic groups also result in very small differences. Regular and Relief subjects differ in the use of *I, me,* and *myself* by only 3 per cent, although Relief subjects lead in the use of these words by 11 per cent at 30 months. Regular subjects surpass Relief cases in use of *other* pronouns (excluding *it*) by a negligible amount, 2 per cent, and the two groups have identical averages for the use of *it.*

As shown in Table 1, possessive pronouns constitute 14 and 13 per cent, respectively, of the total number of personal and possessive pronouns used by Regular and Relief subjects. It is interesting to observe that Davis (2, p. 117) found for her subjects of five and one-half, six and one-half, and nine and one-half years of age that 12, 11, and 13 per cent were the corresponding proportions of possessives used. In the present study there is a decrease of possessive pronouns with age, and the records at 30 and 60 months are 17 and 12 per cent, respectively. Since Regular subjects at 30 months use a noticeably greater number of possessives than do Relief cases the decrease with age is more marked for the upper occupational groups. Girls employ a somewhat larger number of possessives than boys, the greatest differences occurring at the early age levels.

In Table 2 may be found the ratio of specific possessive pronouns to the total number of possessive pronouns by age and sex, for Regular and Relief subjects. Self-interest is evident when possession is concerned, if the data in this table are regarded as a reflection of the attitudes of the subjects. Approximately 79 per cent of the possessive pronouns are of the *self* classification. Although the subjects spoke of other persons, objects and situations more than they spoke of themselves (Table 1), when ownership was involved

TABLE 2
RATIO OF SPECIFIC POSSESSIVE PRONOUNS TO TOTAL NUMBER OF POSSESSIVE PRONOUNS BY AGE, GROUP, AND SEX

Pronoun		My-Mine		Our-Ours		Your-Yours		His-Her-Hers Their-Theirs*	
Person		First		First		Second		Third	
Number		Sing.		Plural		All		All	
C.A.	Sex	Reg.	Rel	Reg.	Rel.	Reg.	Rel.	Reg.	Rel.
30	M.	88.1	93.3	0.0	0.0	10.1	5.6	1.3	0.9
	F.	88.4	89.8	0.0	0.0	8.7	8.4	3.2	2.0
	All	88.3	91.6	0.0	0.0	9.4	7.0	2.3	1.5
36	M.	82.5	88.1	0.0	0.0	14.0	8.7	3.0	2.2
	F.	77.0	86.0	0.1	0.0	17.2	9.6	5.4	3.0
	All	79.8	87.1	0.1	0.0	15.6	9.2	4.2	2.6
42	M.	80.3	83.2	0.1	0.0	13.9	14.8	4.9	1.8
	F.	77.4	80.5	0.2	0.1	16.5	15.5	5.0	2.7
	All	78.9	81.9	0.2	0.1	15.2	15.2	5.0	2.3
48	M.	73.4	81.8	0.2	0.1	20.2	12.9	6.4	4.0
	F	70.7	75.2	0.2	0.2	23.1	18.8	6.5	5.2
	All	72.1	78.5	0.2	0.2	21.7	15.9	6.5	4.6
54	M.	74.0	81.2	0.3	0.1	18.8	12.4	5.8	4.9
	F.	66.4	72.5	0.2	0.2	27.6	23.1	5.9	3.8
	All	70.2	76.9	0.3	0.2	23.2	17.8	5.9	4.4
60	M.	71.6	75.5	0.2	0.3	22.1	19.1	5.1	5.6
	F.	62.1	73.4	0.3	0.3	30.5	18.4	6.2	6.7
	All	66.9	74.5	0.3	0.3	26.3	18.8	5.7	6.2
All	M.	78.3	83.9	0.1	0.1	16.5	12.3	4.4	3.2
	F.	73.7	79.6	0.2	0.1	20.6	15.6	5.4	3.9
	All	76.0	81.8	0.2	0.1	18.6	14.0	4.9	3.6

*This group also includes the possessive pronoun, *its*

(Table 2) they spoke of themselves, as related to possessions, approximately four times more than they spoke of others. Self-assertion, accompanied by varying degrees of emotion, occurred in numerous instances when the problem of property was the issue.

The concept of joint ownership, as shown by the use of *our-ours,* is almost entirely absent in the subjects. The use of these words increased with age but at no level surpassed 0.3 per cent.

Pronouns of the second person rank next to those of the first person singular, and they constitute 16.3 per cent of the possessive pronouns. Only 4.3 per cent were those of the third person, an interesting possible index as to the social attitudes of the subjects.

Regular subjects and girls surpass the contrasting groups in the use of *other* pronouns of the possessive type, a superiority which has been suggested as indicative of greater socialization on the part of these groups. Differences between socio-economic groups are noticeable in connection with the use of *your-yours*. Regular subjects employ these words more than the less fortunate cases at almost all age levels. Sex differences also are marked in connection with the use of the second person, the largest differences occurring at the upper age levels. Relief subjects and boys somewhat surpass the contrasting groups in the use of the *ego* pronouns.

Possessive *self* pronouns decrease from 90 per cent at 30 months to 71 per cent at 60 months. An increase with age is especially noticeable in possessives of the second person, the average for the youngest subjects being 8.2 per cent, and for the oldest subjects 22.6 per cent. Possessives of the third person increase from 1.9 per cent to 6 per cent for these age groups.

Apparently there is a marked development of social consciousness with age, and a relative decrease in self-assertive behavior, as judged by the recorded proportions of possessive pronouns. Inasmuch as no decrease with age was found for first person singular personal pronouns (Table 1) it is possible that possessive pronouns of the first person singular (Table 2) constitute the better index of social development. *Other* pronouns increase with age, as shown both in Tables 1 and 2, but the gain for such possessive pronouns is larger than that for personal pronouns. Again possessive pronouns may be considered as possibly the more valuable index of the growth of social consciousness.

Summary

A study of the ratio of specific personal pronouns to the total number of personal and possessive pronouns reveals the following:

1. Pronouns of the first person singular number account for the largest proportion, 38 per cent, of pronouns. The subjects used *I*, *me*, and *myself* more than all *other* personal pronouns, excluding *it*, combined.

2. When *it* and *other* pronouns were combined it was found that the subjects referred more often to other persons, or to things and situations, than to themselves as specific individuals, the respective proportions being 50 and 38 per cent.

3. Personal pronouns of the second and third persons constitute 16 and 12 per cent of the total. Only about 5 per cent of the pronouns are those of the first person plural number.

4. The subjects do not become less egocentric with age, as measured by their use of first personal singular pronouns. However, the older children talk proportionately less about objects and conditions, a practice which involves the use of *it*, and more about and to other people, a practice which involves the use of *other* (excluding *it*) pronouns.

5. Sex and socio-economic differences for the contrasting groups are small. The largest group difference was found to be the greater use of *it* by boys than by girls.

A study of possessive pronouns reveals the following:

1. Possessive pronouns constitute 14 per cent of the total number of personal and possessive pronouns used by the subjects.

2. Approximately 79 per cent of the possessive pronouns are of the *self* classification. Pronouns of the second and third persons constitute, respectively, about 16 and 4 per cent, and the use of *our-ours* averages only 0.2 per cent.

3. Regular subjects and girls surpass the contrasting groups in the use of *other* pronouns of the possessive type, a superiority which has been suggested as indicative of greater social consciousness.

4. Possessive *self* pronouns decrease from 90 per cent at 30 months to 71 per cent at 60 months, and possessive pronouns referring to *others* increase correspondingly from 10 to 29 per cent. This seems to indicate that there is a marked development of social consciousness with age.

5. Since greater sex, socio-economic, and age differences are noted in the use of possessive pronouns than personal pronouns, in future studies it is important that the former be carefully examined to see if they reveal differences between groups in social development.

References

1. Boyd, W. The development of a child's vocabulary. *Ped. Sem.*, 1914, **21**, 95-124.
2. Davis, E. A. The development of linguistic skill in twins, singletons with siblings, and only children from age five to ten years. *Univ. Minn. Inst. Child Welf. Monog. Ser.*, 1937, **14**. Pp x+165.

3. DREVER, J. A study of children's vocabularies. I and II. *J. Exper. Ped.*, 1915-16, **3**, 34-43, 96-103, 182-188.

4. FISHER, M. S. Language patterns of preschool children. *Teach Coll. Child Devel. Monog.*, 1934, **15**. Pp xvi+88.

5. GOODENOUGH, F. L., & ANDERSON, J. E. Experimental Child Study New York: Century, 1931. Pp xii+546.

6. JESPERSEN, O. Essentials of English Grammar. New York: Holt, 1933. Pp 387.

7. LOW, A. A. Studies in infant speech and thought. I. The development of sentence structure in infancy from the standpoint of grammar. *Univ. Ill. Bull.*, 1936, **33**, No. 39 Pp. 71.

8. MARKEY, J F. The Symbolic Process and its Integration in Children. New York: Harcourt, Brace, 1928. Pp xii+192.

9. YOUNG, F. M. An analysis of certain variables in a developmental study of language. *Genetic Psychol Monog.*, 1941, **23**, 3-141.

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A PREDICTIVE STUDY OF MUSICAL ACHIEVEMENT*[1]

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The aim of this paper[2] is to report results of a follow-up study in which several measures frequently employed for the purpose of predicting success in music were used, and to indicate the practical implications of these results.

A. The Subjects

One hundred and twenty-two boys and girls of the Music and Art High School in New York City served as the subjects. A small preliminary study was made on the data available for 42 pupils, in the first group to be enrolled in the school. The major study was based on the records of the 80 students[3] in the second entering class whose records were available. This group included those who had withdrawn from the school before the end of the sixth term. Fifty-nine of these subjects were instrumental students and 21 were students of voice. The school which they attended was organized in February, 1936, by the Board of Education of New York City. The purpose of the school is to give intensive music or art training, usually in conjunction with the regular college preparatory course, to a small group of talented boys and girls who pass a rigid entrance examination.

B. The Measures Employed

The measures administered by the school included the following: (*a*) A performance test, subjectively administered and scored by a

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[1]A more complete account of the data presented in this paper may be found in the writer's unpublished thesis submitted in partial fulfillment of requirements for the Master's Degree, College of the City of New York, 1940.

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[3]The records of students from junior high schools who were admitted to the second or third term were not included.

member of the music faculty of the school. This rating was based on the playing or singing of a prepared musical selection; the sight reading of a simple composition; and the reproduction of several pitch and rhythm exercises presented by the examiner. (*b*) Amount of previous music training, determined by an interview. (*c*) Elementary school record, including date of birth, intelligence quotients,[4] and scholastic grades.[5] (*d*) Five sub-tests of the Kwalwasser-Dykema *Test of Musical Ability:* Tonal Memory, Quality Discrimination, Intensity Discrimination, Time Discrimination, and Rhythm Discrimination.[6]

The following measures were used as criteria of success: (*a*) The average of all the final marks received in academic courses during six terms. (*b*) The average for music theory, taken one period a day for six terms. (*c*) The mark on the state Regents Examination in music. (*d*) The average grade received in voice or instrumental training, taken one period daily for a minimum of four semesters. (*e*) The average mark for participating in choral or orchestral classes, one or two periods a day for six terms.

C. The Preliminary Study

An investigation was made of the relationship between achievement in music theory after six terms of study and the following predictive measures: the five K-D tests, the performance test, and the intelligence quotient. This group of 42 students was given the K-D tests three months after entering the school.[7]

The correlations are presented in Table 1. The coefficients for the *K-D* tests, taken separately or totally, do not differ reliably from zero; only the Tonal Memory test shows a correlation approaching statistical reliability. Correlation between performance test and theory average, whether based on the average for six terms or the last two terms only, is positive but barely three times its standard error. The only correlation of substantial size is that between theory

[4]Usually based on the Terman *Group Test of Mental Ability* or the Otis *Self-Administering Test of Mental Ability.*

[5]This was computed from the average of all the academic marks received in the eighth grade.

[6]These five parts will hereafter be referred to as the *K-D* Tests.

[7]At present the entire battery of 10 tests is administered on the day the performance test is given and is one of the determining factors for admission to the school.

TABLE 1
SPEARMAN RANK-DIFFERENCE COEFFICIENTS OF CORRELATION BETWEEN PREDICTIVE MEASURES AND THEORY MARKS FOR THE 42 SUBJECTS OF THE PRELIMINARY STUDY

Test	Music theory average for six terms rho	Music theory average for fifth and sixth terms only rho	Performance test score rho
K-D Tonal Memory	.19	.29	.28
K-D Quality Discrimination	—.01	—.07	.09
K-D Intensity Discrimination	.02	—.03	—.09
K-D Rhythm Discrimination	—.02	—.06	—.20
K-D Time Discrimination	—.13	—.10	.01
K-D Total Score	.02	—.05	.04
Intelligence Quotient	.53+	.56+	.24
Performance Test	.29	.32	—

+Standard error of this is .09, for all others it is .10

average and intelligence quotient, which is .53. This compares favorably with correlations reported for intelligence quotient and academic standing in general high schools.

D. THE MAIN STUDY

Because of the challenging implications contained in the preliminary investigation, a more intensive study was made of the records of the second group to be enrolled in the school.

1. *Reliability of the Measures*

Since the possibility of predicting success is limited by the reliabilities of both the predictive measures and the criteria of success, an inspection of the reliability coefficients given in Table 2 is very instructive. The reliabilities[8] of the six term averages obtained for orchestra, instrument, music theory, and academic studies, are all .80 or more. While this does not prove anything about the validity of the marks given by the teachers, it indicates a substantial agreement among the different teachers in the music courses as well as in the academic courses. The extremely high reliability of the academic average is probably due to the fact that it was based on the

[8]All coefficients of correlation of the main study were computed by the Pearson product moment method.

TABLE 2
RELIABILITY COEFFICIENT, RANGE, PERCENTILE RANGE, MEAN, AND STANDARD DEVIATION OF EACH MEASURE FOR 80 SUBJECTS

Test or subject	Reliability coefficient	Score range	Mean score	*SD*	Percentile range
K-D Tonal Memory	.52†	16- 25	21.1	2.2	54-100
K-D Quality Discrimination	.45†	16- 29	23.8	2.6	12-100
K-D Intensity Discrimination	.35†	12- 27	22.8	3.0	1- 99
K-D Rhythm Discrimination	.39†	16- 23	19.3	1.7	36-100
K-D Time Discrimination	.09	13- 23	18.5	2.8	18- 98
K-D Total of 5 Tests		88-120	105.5	6.2	
Performance Test Average		22-100	60.7	15.0	
Intelligence Quotient		89-159	117.5	13.7	
Age (in years and months)		11.6- 15.6	13.5	.8	
Length of Prior Study (months)		0- 84	39.6	24.2	
Elementary Academic Average*		65- 90	83.9	4.8	
Orchestra Average	.80‡	78- 95	86.7	3.7	
Instrument Average	.83‡	75- 97	87.0	4.7	
Theory Average	.82‡	50- 97	82.2	9.4	
Academic Average	.97‡	50- 93	78.7	8.0	
Regents Mark**		65-100	83.2	9.7	

*Seventy-nine subjects were available.

**Sixty-five subjects were available.

†Test-retest correlation for 69 students retested after 12 months.

‡Correlation between average grade for even-numbered terms and average grade for odd-numbered terms for 79 students, using the Spearman-Brown Formula.

average of three or more courses each term, while each music course was treated separately.

In sharp contrast to the satisfactory reliabilities of the teachers' grades are the low reliabilities of the *K-D* tests. These were test-retest correlations for 69 students retested after a 12-month interval. Only one of the five *K-D* tests, Tonal Memory, has a reliability coefficient as high as .52, and for the Time Discrimination the coefficient is only .09. These reliability coefficients are far below accepted standards for tests intended to be used in the guidance or selection of individuals.

The possibility that these reliability coefficients are artificially or unduly low because the group was a highly selected one deserves

attention. Inspection of Table 2 shows that on the *K-D* tests the group was, on the whole, above average since a perfect score in Quality Discrimination and Intensity Discrimination is 30, and on the others it is 25. However, there was an appreciable range on each of the five tests shown by the range of percentile equivalents, and the Tonal Memory test, in which the percentile range was smallest, had the highest re-test coefficient. This indicates that the low reliabilities of the other four tests cannot be explained away as being due to a homogeneous population. The possibility that the coefficients are low because of greater homogeneity at second testing, due to the effects of intervening training, is disproved (Table 3) by the fact that on each

TABLE 3

RANGE, PERCENTILE RANGE, MEAN, STANDARD DEVIATION, AND CRITICAL RATIOS OF THE *K-D* TESTS ADMINISTERED IN 1937 AND 1938

	N	Score range	Percentile range of scores	Mean score	SD	$Diff./\sigma_{diff.}$ Means	SD's
Tonal Memory							
1937	80	16-25	54-100	21.18	2.24	.04	6.89
1938	69	14-25	31-100	21.15	5 96		
Quality Discrimination							
1937	80	16-29	12-100	23 80	2.55	1.73	5.17
1938	69	19-29	32-100	24.94	4.98		
Intensity Discrimination							
1937	80	12-27	1- 99	22.78	2.99	1.62	3.64
1938	69	10-27	1- 99	23.83	4.63		
Time Discrimination							
1937	80	13-23	18- 98	18.48	2.82	1 84	3.98
1938	69	11-25	9-100	19 66	4.65		
Rhythm Discrimination							
1937	80	16-23	36-100	19.31	1.74	1 51	7.12
1938	69	14-23	13-100	20.22	4.73		

of the five tests variability was slightly greater on second testing than on first testing. It should also be noted that the *K-D* tests were originally administered three months after the beginning of the term, and were not part of the admission process. While small gains were made on four of the *K-D* tests, none of the changes was statistically reliable. This would seem to indicate that neither increased maturity nor training during the year interval markedly increased the scores.[9]

[9]For a summary of other studies reporting on the reliability of the

2. *The Scores Obtained*

The students displayed considerable variability in the other predictive measures as well as in the *K-D* tests. Although only those deemed specially talented were admitted to the school, some low scores are found on each of the measures as shown in Table 2. Intelligence quotients ranged as low as 89 and elementary school averages as low as 65. The performance test showed a range from 22 to 100 (the maximum score possible), while the range for prior music study was from 0 to 84 months. The group was as a whole definitely superior, with a mean elementary school average of 83.9 and a mean *IQ* of 117.5. They ranged in age at the time of entrance from 11.5 to 15.5, with the mean at 13.5 years, indicating accelerated progress. Where students with very low elementary school records, *IQ*'s, or performance test scores were accepted, it was because of compensating high rating in other measures. As has been noted, the *K-D* tests were not used as admission tests.

The achievement in the high school was decidedly superior, particularly in the music courses. Comparison of the Regents average with the theory average seems to indicate that the teachers were using fair marking standards.

3. *Correlations Obtained*

The correlations obtained for the measures included in this study are given in Table 4. So far as the *K-D* tests are concerned, the results are almost as disappointing as in the preliminary study. Only the Rhythm Discrimination test shows correlations with grades in music courses that are reliably greater than zero. The Tonal Memory and Intensity tests show consistently positive but very low correlations with the criteria. In view of the fact that the reliability coefficient of the Rhythm test is only .39 in the present study, its coefficients of .35, .31, and .36 with theory, instrument, and orchestra grades indicate that a test of this sort, improved to the point where it would have satisfactory reliability, might be of really practical value in musical guidance. The same is true to a lesser extent of the Tonal Memory test. The slight positive r's for the

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Kwalwasser-Dykema Tests see Bienstock, S. F., "A Review of Recent Studies of Musical Aptitude" (in press).

TABLE 4
VARIOUS CORRELATIONS OF THE STUDY

	Theory $N = 80$ r	Instrument (or voice) average $N = 80$ r	Orchestral (or choral) average $N = 80$ r	Academic average $N = 80$ r	Regents mark $N = 65$ r	IQ $N = 80$ r
K-D Tonal Memory	16	.26	.15	—.02	.43	.16
K-D Quality Discrimination	— 10	.05	—.11	—.04	.07	.01
K-D Intensity Discrimination	.16	.12	.13	.12	.33	29
K-D Rhythm Discrimination	.35	.31	.36	.24	.19	.21
K-D Time Discrimination	—.06	—.12	—.15	—.01	—.08	—.10
K-D Total of Five Tests	.18	20	.13	.09	.39	.22
Performance Test Average	.29	.25	.18	.24	.29	31
Intelligence Quotient	.58	10	03	61	.44	—
Age	—.40	— 05	— 06	—.52	—.16	—.60
Length of Prior Study	.26	.17	.14	.06	.12	— 24
Elementary Academic Average[r]	.39	—.12	— 28	.40	.08	.58
Theory	—	25	.13	.71	.64	58
Instrument or Voice	.25	—	.80	06	.25	.10
Orchestra or Chorus	.13	.80	—	— 01	.07	.03
Academic Average	.71	06	—.01	—	.44	.61
Regents Mark	64	.25	.07	.44	—	.44

Standard errors when $N = 80$ Size of r	SE	Standard errors when $N = 65$ Size of r	SE
r .00-.39	.10	r .00-.49	.10
r 40-49	.09	r .50-.57	09
r .50-.59	.08	r 58-64	.08
r .60-64	07	r .65-.69	.07
r 65-72	.06	r .70-.74	.06
r .73-78	.05	r 75-.79	05
r 79-83	.04	r .80-.85	.04
r 84-.88	.03	r .86-.89	.03
r 89-.93	.02	r 90-.94	.02

[r]Seventy-nine subjects were used for this measure

Intensity test are probably explainable in terms of its correlation with *IQ*. The total score for the five *K-D* tests is of less value than the Rhythm test by itself.

The performance test yielded r's consistently less than .30 when correlated with school marks. These results are surprisingly low, particularly in view of the fact that this test was administered by

the same teachers who later graded the students on their instrumental or orchestral work. Amount of prior study shows even lower predictive value. The poor predictive results for these two measures may be explained in part by the following: (*a*) a great many of the voice students had no prior music training; (*b*) most of those who had studied piano before entrance shifted to orchestral instruments; (*c*) the reliability of the performance test could not be determined, and since it was the subjective impression of a single judge with no predetermined or uniform correction for amount of previous training, it may very well have had low reliability. Obvious ways to increase its reliability would be to average the ratings of two or more judges for each applicant, to establish specific standards for grading the performance on each instrument, and to allow uniform corrections for previous training.

Intelligence quotient, elementary school average, and age are substantially interrelated to the extent of .58 or .60. These three predictive measures show the same pattern of relationship with the measures of achievement. They have *r*'s of substantial size with marks in theory and in academic studies, and *r*'s of negligible size with instrument and orchestra marks. The negative *r*'s for age indicate that the younger students tend to do better work than the older ones. The intelligence quotient is definitely superior to age and elementary school average as a basis for prediction, its *r*'s of .50 with theory and .61 with academic average being considerably higher than the corresponding *r*'s of —.40 and —.52 for age, and of .39 and .40 for elementary school average.

The correlation between instrument average and orchestra average is high, .80, while correlations of both of these with theory are very low, .25 and .13 respectively. Theory, however, has a coefficient of .71 with academic average, and its correlation with intelligence quotient, age, and elementary average correspond closely to those for academic average. The obvious conclusion to be drawn is that the study of musical theory is largely an academic subject and calls for the same general abilities as other academic subjects. Success in instrumental or vocal study, measured in solo performance or in orchestral or choral work, shows practically no relationship to theory, to academic subjects in general, or to intelligence.

Computation of a multiple correlation coefficient indicated that

age and elementary school average added very little to the relationship between intelligence quotient and musical theory, raising it from .58 only to .60. Combining intelligence quotient and the *K-D* Rhythm Discrimination test gave a multiple r of .62. No combination of the predictive measures used in this study was at all satisfactory for predicting grades in instrumental or orchestral work.

To supplement the correlational analysis of the data an inspection was made of the records[10] of the highest and lowest ranking 10 per cent of the students on each measure. It was found that those who ranked very high on one of the initial measures generally ranked high on all the others, and similarly a very low score on one initial test was usually accompanied by low scores in other tests. The consistent trend seemed to indicate that students who received the highest scores on their initial predictive tests received better than average achievement marks. The one exception was in applied music (average of instrumental and orchestral marks), in which high predictive scores were not necessarily accompanied by grades above average. The individual performance test was no better for predicting success in applied music than were any of the other measures. Students who received the lowest scores[11] on the initial tests were definitely and consistently below average in applied music as well as in other subjects.

A comparison of the records of the voice students and the instrumental students indicated the following: (*a*) the instrumental students were reliably superior on all of the prognostic measures with the one exception of the *K-D* tests; (*b*) the instrumental students earned significantly higher grades than the voice students in all subjects in which both groups participated.

E. General Summary

The data for this investigation were obtained from the records of 122 boys and girls of the Music and Art High School in New York City. The record for each student included: his score on five of the

[10]This tabulation may be found in the study by Bienstock, S. F., "The Prediction of Musical Achievement," unpublished Master's Thesis, School of Education, College of the City of New York, 1940.

[11]Students who left the school after one or two years could not be regarded as the lowest ranking since only three of the eight who withdrew did so because of poor marks. Even these three received average or better marks in applied music.

Kwalwasser-Dykema *Tests of Musical Ability;* his grade on an individual performance test; his *IQ;* his final mark for elementary school academic courses; an evaluation of his previous music training; as well as the marks earned in music theory, applied music, and academic subjects for each of six terms in high school. The findings indicated that:

1. The Kwalwasser-Dykema tests were too unreliable to be used for the prediction of individual success in music. Improvement in the reliability of the Rhythm and the Tonal Memory tests might make these tests practicable for guidance purposes.

2. The interval of one year of musical training in the Music and Art High School did not reliably increase the scores on the *K-D* battery.

3. There was a positive correlational trend between the Kwalwasser-Dykema tests and success in theoretic and applied music but it was too low to be of practical value.

4. Teachers' marks used as criteria in this study had adequate reliability for use as measures of achievement.

5. The individual performance test used in this study yielded only slightly higher coefficients than the *K-D* tests when correlated with the music marks, and was unsatisfactory for prognosticating musical achievement.

6. Marks in applied music (musical performance) were generally prognosticated with much less accuracy than were marks in theoretic music.

7. The most effective measures for the prediction of success in theoretic music were the intelligence quotient and the age of the students, while the least contributive was the extent of prior music training and the performance test score.

8. The instrumental students were, as a group, superior to the vocal students on all the predictive measures, and also on all directly comparable measures of achievement.

9. The findings from the analysis of the records of the highest and the lowest ranking students conformed in general to the trends observed for the group as a whole. The measures were more effective for predicting failure than for predicting success. As a rule very low scores on several of the predictive measures were almost certain

to indicate poor achievement, whereas high initial scores did not insure superior achievement.

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THE BIOLOGICAL ASPECTS OF STUTTERING*

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A considerable amount of investigation and experimentation has been going on for the past few years to determine whether stutterers, aside from their speech, are different from non-stutterers. Our purpose in this paper will be to review the results of some of these studies which deal with the biological aspects of stuttering. The psychological aspects will be omitted not because they are considered unimportant, but rather because it is difficult to determine whether the psychological concomitants are causes or effects of stuttering. So many studies have recently been completed, and so many more are at present in progress, that it will not be possible, because of the spatial limits of this paper, to review more than a small percentage of available studies.

A. THE FAMILY BACKGROUND OF STUTTERERS

The concensus of evidence of several recent studies (16, 17) indicates that there is a strong likelihood that the stutterer has more stuttering forbears than the non-stutterer. Nelson made a careful study of 204 stuttering families in which more than 50 per cent showed stuttering in the family strain for several generations.

There is a greater incidence of left-handedness in the stutterer's family than in the family of normal speakers. This point has been brought out and substantiated in a series of studies including those of Wallin (15), Milisen (8), Quinan (10), and Nelson (17).

A study of the family background reveals that there are more twins in the families of stutterers than in those of normal speakers. Berry (1) studied 250 pairs of twins and found that stuttering occurred more frequently than in families without twins. Berry, however, is not willing to assume that the twinning is a biological concomitant of stuttering. It is possible, she points out, that being a

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twin may have a psychological influence upon speech which may manifest itself in stuttering.

B. Pre-Natal Conditions

We have some information of the pre-natal conditions of the stutterer. Berry (2) studied the birth records of 227 stutterers and a like number of normal speakers. She found no demonstrable difference between the two groups in the conditions associated with the pregnancy of the mother and the delivery of the child. Four mothers of stutterers were afflicted with exophthalmic goiter and thyrotoxicosis, whereas there was no mention of this disorder in the records of the control group. Though this is an interesting point, so few cases are involved that the difference has no statistical significance. In regard to type of delivery, an examination of Berry's data indicates that there was a greater incidence of abnormal deliveries for the stutterers than for the control group though once again the points of difference involve too few cases to establish statistical significance. Of the 227 stutterers, 13 were born after prolonged labor, 6 were breach presentations, and 6 were cyanotic. The figures for the control group (232 cases involved here) were: 8 prolonged labor, 1 breach presentation, and 2 cyanotic. The little knowledge we have indicates that untoward pre-natal conditions may be associated with stuttering. Considerable research is needed here before a definite conclusion may be reached.

C. Early Developmental History

Birth weight, age to which breast feeding was continued, age of walking and talking were studied by Berry (2) as indices in the early developmental history of stutterers. Berry found that the average birth weight of 71 stutterers exceeded somewhat that of 145 controls, (7.461 lbs. compared with 7.131 lbs.). The difference between the two groups was too small to be statistically significant (critical ratio 0.319).

Breast feeding was continued two and a half months longer on the average for the stutterers than for the controls (10.634 months compared with 8.172 months). The critical ratio of 3.255 would indicate that this is a real difference, but Berry feels that a large

number of variables surrounding possible reasons for breast feeding precludes our accepting the difference as a positive finding.

Berry's stuttering children were retarded in walking when compared with her controls. The mean age in months for the stutterers was 14.8 compared with 13.54 for the controls. If we compare the stutterers in Berry's study with other established norms for walking we find an increased difference. Hardy and Hoefer (5) for example, established a mean of 13.01 months for 403 children. It seems safe to conclude on the presented evidence that stutterers begin to walk later than normal speaking children.

Berry's data permits us to make comparisons as to when speech began (first words) and when speech was produced so as to be intelligible to persons outside of the subjects' immediate families (intelligible speech). In both respects the stutterers are retarded when compared with the controls. The average age in months at which 243 stutterers began to speak was 23.54 compared with 16.12 for the controls. The critical ratio of the difference is large, (8.149), indicating that it is statistically significant. The average age in months for intelligible speech was 36.21 for the stutterers compared with 24.18 for the controls. Again the critical ratio is large (6.854) so that the chances are 100 in 100 that the true difference is greater than zero. There is no possibility that the factor of intelligence might have had undue influence on the results. Intelligence quotients, which were available for 166 stutterers, reveal an average *IQ* of .992 for the group, compared with an average *IQ* of .976 for the 161 control subjects for whom intelligence quotients were available.

D. Medical Background of Stutterers

A study (3) of the medical history of stuttering children reveals that specific respiratory diseases involving the respiratory system and accompanied by high fever and nervous disorders such as encephalitis, epilepsy, and convulsions appear far more frequently and are present in more severe form than we would normally expect. Recent evidence also indicates that the incidence of allergic reactions is greater among stutterers than among normal speakers. Card (4) administered interdermal tests for allergic reactions to a group of 40 stutterers. He found that all of them showed positive reactions and

observed that the severity of stuttering was usually in proportion to the number and/or severity of the stutterer's reactions.

Anomalies in the medical background of stutterers appear aside from specific disease history. Kopp's (7) research would lead us to believe that stutterers present a picture of disturbed metabolism. Though biochemical substances are present in normal quantities in stutterers, the relative balance between the substances is not maintained. Total serum calcium and inorganic phosphates normally appear in a negative correlation; in the stutterer, they are positively correlated. Total serum calcium and total protein in normals are in direct ratio; in stutterers they are related inversely. Normally, when potassium is increased, total protein decreases; in the stutterer, they are found to increase together. Karlin and Sobel (6) checked these results in an experiment constructed to remedy the weakness they considered to be present in Kopp's. They were careful, for example, to match the stutterers and normals for age, sex, height, and weight, and to use a "less optimistic" statistical analysis. They found differences between stutterers and non-stutterers along the general line indicated by Kopp, but the differences were small, and except for the findings on potassium, not statistically significant.

The stutterer exhibits peculiarities of breathing both when he is silent and when he is attempting speech. The breathing abnormalities are summarized by Van Riper (14) and include: (*a*) unduly prolonged inspiration or expiration; (*b*) significantly different simultaneous breathing patterns for abdomen and thorax; (*c*) attempts at speech during inhalation (speech is normally produced on expired breath); (*d*) synchronism of laryngeal and respiratory movements; (*e*) diametrical opposition of the action of the thorax to the abdomen; (*f*) attempts at speech after the normal flow of breath has been expired; (*g*) the presence of a marked tremor; (*h*) shallow and frequently irregular respiration. These peculiarities characterize the breathing of stutterers as a group. Differences exist between male and female stutterers, males approximating normal controls in some respects and females approximating normal controls in others (9). A study by Starr (11) suggests that differences in the hydrogen-ion concentration (pH) or acidity of the blood may account for the respiratory arrhythmia of the stutterer. Starr found that the alveolar CO_2 of the stutterer is higher than we would normally

expect. Increased CO_2 would exhaust the alkaline buffers in the blood by which its effects are ordinarily neutralized, thus producing a lowered pH or acidity. Starr's findings were not substantiated in a later study by Kopp (7).

A neurological distinction between stutterers and non-stutterers has been sought for some time. The conclusions of Travis and Johnson (13) to the effect that ". . . . on the whole, stutterers differ from normal speakers in being characterized by a relative lack of unilaterality of motor lead control" summarizes the general conclusions of studies along this line. Attempts to corroborate this conclusion by recording and analyzing brain potentials from stutterers and comparing them with non-stutterers have thus far not proved very fruitful (12).

E. Conclusions

The biological approach to the study of stuttering has presented us with evidence which seems to indicate that *some* stutterers may be constitutionally different persons from most normal speakers. Such a conclusion is to be accepted tentatively. Further research is needed and experimental results should be checked and rechecked. In many cases it needs to be made clear whether the obtained results are after-effects or causes of stuttering.

References

1. Berry, M. F. A common denominator in twinning and stuttering, *J. Speech Dis.*, 1938, **3**, 51-57.
2. ———. The developmental history of stuttering children, *J. Pediat.*, 1938, **12**, 209-218.
3. ———. The medical history of stuttering children, *Speech Monog.*, 1938, **10**, No. 1.
4. Card, R. E. A study of allergy in relation to stuttering, *J. Speech Dis.*, 1939, **4**, 223-230.
5. Hardy, M. C., & C. H. Hoefer. Healthy growth. Chicago: Univ. Chicago Press, 1936.
6. Karlin, I. W., & Sobel, A. E. A comparative study of the blood chemistry of stutterers and non-stutterers. *Speech Monog.*, 1940, **7**, 75-84.
7. Kopp, G. Metabolic studies of stutterers. *Speech Monog.*, 1934, **1**, No. 1.
8. Milisen, R. A comparative study of stutterers, former stutterers, and normal speakers whose handedness has been changed. Thesis, University of Iowa, 1933.

9. PALMER, M. F., & GILLETT, A. M. Respiratory cardiac arrhythmia in stuttering. *J. Speech Dis.*, 1939, **4**, 133-140.
10. QUINAN, C. Sinistrality in relation to high blood pressure and defects of speech. *Arch. Med.*, 1921, 255-61.
11. STARR, H. B The Hydrogen-ion concentration of the mixed saliva. *Amer. J. Psychol.*, 1922, **53**, 394.
12. TRAVIS, L. E., & KNOTT, J. R. Bilaterally recorded brain potentials from normal speakers and stutterers. *J. Speech Dis*, 1937, **2**, 239-241.
13. TRAVIS, L. E., & JOHNSON, W. Stuttering and the concept of handedness. *Psychol. Rev.*, 1934, **41**, 534-561.
14. VAN RIPER, C. Speech Correction. New York: Prentice-Hall, 1939.
15. WALLIN, J. E. Studies of mental defects and handicaps. *Miami Univ. Bull.*, 1925, Series 22, No. 5.
16. WEPMAN, J. M. Is stuttering inherited? M.A. Thesis, University of Wisconsin, 1934 (unpublished)
17. WEST, R, NELSON, S., & BERRY M. F. The heredity of stuttering. *Quar. J. Speech*, 1939, **25**, 23-30.

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SHORT ARTICLES AND NOTES

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SOME EFFECTS OF A NURSERY SCHOOL-PARENT EDUCATION PROGRAM ON A GROUP OF THREE-YEAR-OLDS*

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A. INTRODUCTION

Since 1933 Hiram House, a private social agency, has conducted in collaboration with the Cleveland Board of Education, an experimental community program known as the Paul Revere Neighborhood Center. This program of cooperation between a private and public agency is unique in size and scope, in actuality being comprised of activity programs in three public schools: an elementary school, a junior high school, and a senior high school.

The present report, however, is concerned with only one portion of the pre-school work now being conducted in the Paul Revere Elementary School. The entire program at this particular school is concerned mainly with the growth and development (mental, physical, and social) of younger children, the units known as the Family Conservation Department and Progress City constituting the *modus operandi*. It is with the three-year-olds enrolled during the school year 1939-1940 in the nursery school of the Family Conservation Department that the present report is concerned.

B. PURPOSE

It was the felt need to evaluate objectively the efficacy of the nursery school-parent education program of the Paul Revere Neigh-

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[1]The author wishes to acknowledge her indebtedness to Mrs. Janice Work Smith, who was largely responsible for planning the study on which the present article is based, and to Mrs. Helen Gaensslen, head teacher of the parent and preschool groups.

borhood Center that was responsible for initiating the experiment reported here, so that the *raison d'etre* was of a practical rather than an academic nature. Just what was the program accomplishing in the way of promoting growth and development? Subjective comments of parents and of kindergarten teachers of the public school, into whose classes some of the nursery school children had been graduated, were optimistic, and, indeed, flattering, but the staff was interested in accumulating a yearly, objective evaluation of their work. Hence, in 1939 a longitudinal research program, emanating from the desire to improve a service organization, was initiated.

In view of the present state of the nature-nurture controversy, especially with respect to the possible contribution of nursery school training to that area of child development presumably measured by the *IQ*, the results of the first phase of the longitudinal program are of particular interest inasmuch as the experiment can lay claim to distinctiveness on five counts: (*a*) It is probably the first study to be made of a nursery school-parent education program carried on in a public school by a private social agency. (*b*) As a consequence of its peculiar setting and organization, the socio-economic level of the children included in the survey is inferior to that reported in most of the previous investigations on the effects of nursery school training on the *IQ*. In this connection it is of interest to note that Olson and Hughes (2, p. 244) conclude that their analysis failed to show ". . . any conclusive evidence for growth changes related to nursery school experience in this privileged group of children. One might argue on theoretical grounds that the home environment for these children was already nearly optimum, irrespective of nursery school attendance, that further stimulus and regimen could not be expected to alter the growth curves in mentality or other areas. Where children are living under some degree of deprivation, additional nurture might more nearly permit the realization of potential growth in achieved growth. Such demonstrations must come from experiments with other types of children." (*c*) The experiment presented here was confined to children from a relatively narrow age range (three-year-olds born between October 16, 1935 and October 15, 1936) who were potential public school children. (*d*) A control group equally restricted as to age-growing and to public

school potentiality from a community similar in educational and socio-economic status was employed as a basis of comparison.

C. SUBJECTS

For the sake of convenience the 21 children of the nursery school or experimental group will be designated here as Group *A* and the 21 members of the non-nursery school or control group as Group *B*. Both groups live in communities estimated by Howard Whipple Green (1) as belonging in the fifth-tenth economic group of Cleveland's population. In other words, both belong to the economic classification ordinarily designated as lower-middle class.

In an attempt to further equate the groups, the mid-parent educational levels as well as the occupational levels of both groups were compared. When the average mid-parent educational age was computed in terms of the number of grades completed, the resultant ratings for both *A* and *B* were 9.6 grades. When the groups were compared on the basis of father-occupational level, a similar comparability seemed to be indicated. In Group *A* none of the fathers was classified as belonging to the professional group: 29 per cent belonged to the business and clerical groups, while 71 per cent were classified as skilled workers. The figures for Group *B* are somewhat similar. Again, no fathers were listed as belonging to the professional group: 30 per cent belonged to the business and clerical groups, while 70 per cent were classified as skilled workers. Both analyses seem to justify the conclusion that Groups *A* and *B* were comparable educationally and socio-economically.

In both *A* and *B* groups a fairly wide range of nationalities was represented, most of the parents being first-generation Americans. The variety of nationalities indicated in the two groups was approximately the same except that 14 per cent of Group *A* was of Italian origin, no British (English, Irish, Scotch) being represented in this group. On the other hand 9 per cent of Group *B* was of British origin with no Italian descent being represented.

A further analysis revealed that whereas in 52 per cent of the cases one or more Group *B* parents were of English-speaking origin, only 22 per cent of the Group *A* parents were of English-speaking origin. In short, one might be justified in assuming that partial bi-lingual home situations were more common in the experimental

group since, even though the parents were almost entirely first-generation Americans, in many instances foreign-speaking grand-parents were in frequent contact with the children.

D. The Program

The general outlines of the program of Group *A* did not differ materially from those of any creditable half-day nursery school. Sessions were held each regular school day from 9:00 to 11:30 daily during the period October, 1939, to May, 1940, in a large, well-equipped room in the public school building. An adequately equipped playground provided the opportunity for outdoor play experiences. Circle games, finger painting, music, songs, and stories were, of course, included in the usual indoor routine. Trips for the purpose of broadening the experiential background were incorporated frequently into the program. For example, one such excursion involved a short train-ride, the first for practically every child in the group. Indeed, in this motor-car age, train-rides were so novel an experience for the families from which Group *A* came, that some of the mothers, never having traveled by train, asked to participate in the event.

In addition to the nursery school regime briefly described above, a second very important feature of the entire program for Group *A* involved the fairly intensive parent-education program. Lectures, conferences, and informal discussion groups on child care and training were held at the school. Parents (i.e., mothers) regularly attended morning class once each week, and an evening class once each month was arranged in order to give the fathers an opportunity to participate. An additional approach consisted of two visits per month by the counsellors to each home for the purpose of assisting with problems relating to all phases of child development, home management, and family relations.

Group *B*, of course, presumably experienced only the ordinary home routine typical of the socio-economic and cultural group from which both groups derived.

E. Procedure

Both groups were given the Terman *L Revision of the Binet-Simon Intelligence Test* in the fall of 1939 by a trained examiner, a member of the clinic staff of the Cleveland Public Schools. The school phy-

sician gave each child a thorough physical examination. Paul Revere counsellors then visited each home for the purpose of administering by the interview method, an extensive questionnaire concerned with all aspects of the child's physical and psychological environment, his health history, his development, and his behavior.

In the late spring of 1940 the same measurements were repeated by the same physician; the same examiner again administered Form *L* of the Terman intelligence test, and the same counsellors secured the questionnaire data. The time interval between examinations averaged eight months, data on all cases being collected within the span of approximately one month both in the fall and again in the spring.

F. Results

The small number of cases comprising the basis of the results reported here, of course, preclude the possibility of definitive conclusions. However, at least some compensation for this lack is to be found in the use of a control group and the employment of the same physician, psychologist, and counsellors for the collection of the spring and fall data.

In Table 1 the spring and fall Terman ratings are listed for

TABLE 1
COMPARISON OF GROUP A WITH GROUP B ON THE SPRING AND FALL TERMAN RATINGS

	Group *A*		Group *B*	
	IQ in Fall	*IQ* in Spring	*IQ* in Fall	*IQ* in Spring
Range	*80 to 124*	*83 to 139*	*82 to 130*	*85 to 125*
Mean	102 ± 2.03	111 ± 2.29	109 ± 1.49	109 ± 1.52

Groups *A* and *B*. An examination of this table discloses two points of interest. In the first place, it will be observed that Group *A*, the nursery school or experimental group, rated seven *IQ* points lower than Group *B* at the initial testing. The probable error of the difference between the two means is 2.52, and, consequently, the difference cannot be interpreted as being statistically significant. However, since there are about 89 chances in 100 that a true difference does exist, a possible explanation of the difference between the two obtained averages is perhaps appropriate.

In view of the close agreement of both groups of parents in socio-

economic status and mid-parent educational rating, the seeming disparity in initial rating at first seems anomalous. However, *if* a real difference in initial *IQ* rating does exist between the groups, the most likely explanation for that possible difference probably would be found in the greater frequency of partial or secondary bilingual home situations in Group *A*.

The second point of interest in Table 1 is to be found in the fact that at the conclusion of the nursery school-parent education training period, Group *A* rated two *IQ* points higher than Group *B* in tested intelligence. In other words, Group *A* showed an average gain of nine *IQ* points while Group *B* remained stationary so far as the group average is concerned. However, the probable error of the difference (2.77) does not indicate a significant difference, although it does indicate that there are about 92 chances in 100 that a true difference is present.

When the fall and spring *IQ* averages of Group *A* are compared, it will be observed that the obtained difference is nine *IQ* points. This, according to the probable error of the difference (3.06), is not a significant difference. However, the experimental coefficient $\left(\frac{D}{2.78\sigma_{diff.}}\right)$ of 1.27 indicates that the difference is "probably but not certainly real" and that 96 per cent of the cases are within the range.

Although the findings given here do not justify the formulation of conclusive statements with regard to the effect of nursery school training upon intelligence, nevertheless it would seem that, since the increase in *IQ* points reported for Group *A* approximates statistical significance, tentatively, at least, it might be suggested that the experiential background of that group had been changed sufficiently to raise the functional level, i.e., the tested intelligence, of the experimental group. If the level of tested intelligence was raised, the change should be ascribed, in part at least, to better English language facility, an important factor in performance on a verbal intelligence test such as the Terman.

Comparisons on the basis of physical improvement are indicated in Table 2. In Group *A* 6 per cent of 16 physical defects were improved during the period of participation in the nursery school-parent education program. Of the 33 physical defects found in

TABLE 2
COMPARISON OF GROUP *A* WITH GROUP *B* ON THE BASIS OF THE PHYSICAL IMPROVEMENT SHOWN DURING THE PERIOD OCTOBER, 1939, TO JUNE, 1940

Groups compared	Physical defects Improved	Corrected
Group *A* (16 defects)	6%±3.50	50%±7.36
Group *B* (33 defects)	9%± .88	18%±4.81
Difference between *A* and *B*	3%±3.61	32%±8.79

Group *B* by the school physician at the fall examination, 9 per cent were eliminated by the time of the spring examination. According to these percentages, then, the non-nursery school group exceeded the nursery school group in the extent to which physical defects were improved. However, the fact that the probable error of the difference is not significant together with the fact that there were a greater number of physical defects listed for Group *B*, minimizes the obtained difference of 3 per cent. In Group *A* the percentage of defects corrected, i.e., mechanical defects, exceeds that of Group *B* by 32 per cent, a difference which approximates significance, according to the probable error of 8.79.

Differences between the average height and weight increases were negligible.

From the questionnaire 12 representative items of comparison have been selected and presented in Table 3. Food refusals, the absence of fears, and staying happily in the care of others in the absence of the mother have been taken cursorily as a measurement of emotional adjustment. Dressing alone, washing self, bathing alone, getting own wraps, and caring for own towel and wash cloth have been taken as measures of self-help and independence, habits ordinarily considered to be worthy of development in normal three-year-olds. The provision of a regular 7:30 bed-time, naps in the afternoon, low clothes hangers and towel bars to encourage the development of habits of self-help have been considered as tentative indices of the extent to which parents coöperated in setting the stage for regular regimes and for the establishment of routine habits.

The outstanding feature of Table 2 is the consistency with which Group *A* exceeds Group *B*. It is interesting to note further that in 9 of the 12 items listed the differences found in favor of Group *A* are statistically significant. Rather peculiarly, the only three differ-

TABLE 3

Comparison of Group *A* With Group *B* on the Basis of 12 Questionnaire Items

Items measured	Group *A* Fall	Spring	*Diff.*	$PE_{Diff.}$	Group *B* Fall	Spring	*Diff.*	PE_{Diff}
No food refusals	6±1.40	10±1 54	4	2.09	7±1.46	7±1.46	0	2.06
No fears	8±1.50	12±1.53	4	2.14	14±1.46	8±1.50	6	2.09
Staying happily with others	16±1.32	21±3.09	5	3.36	18±1.08	16±1.32	2	1.71
Dressing alone	7±1.46	19± .90	12	1.72	7±1.46	12±1.53	5	2.11
Washing self	6±1.40	19± .90	12	1.66	16±1.32	14±1.46	2	1.97
Bathing alone	3±1.74	16±1.32	13	2.18	4±1.21	3±1.08	1	1.62
Getting own wraps	11±1.54	20± .66	9	1.68	17±1.21	18±1.08	1	1.62
Caring for towel, cloth	5±1 32	17±1.21	12	1 79	6±1.40	9±1.53	3	2.07
Regular 7:30 bedtime	2± .90	13±1.50	11	1.75	3±1.08	2± .90	1	1.41
Afternoon naps	14±1.46	21±3.09	7	1.30	14±1.46	13±1 50	1	2.09
Low clothes hangers	5±1.32	19± .90	14	1.25	9±1.53	14±1.46	5	2.11
Low towel bars	3±1 08	17±1.21	14	1.62	14±1.46	12±1.53	2	2.11

ences found not to be significant were those considered here to be suggestive of emotional maturity.

G. Summary

1. Group *A*, rating seven *IQ* points lower at the original testing, rated two *IQ* points higher than Group *B* at the close of the eight-month interval. The obtained difference approached statistical significance.

2. It was found that there were negligible differences in height and weight averages for the two groups at the end of the training period.

3. There were no dignificant differences between Groups *A* and *B* in the percentage of physical defects improved. However Group *A* exceeded Group *B* in the percentage of physical defects corrected to an extent approaching significance.

4. Of the 12 measures used to gauge changes in emotional maturity, in the development of routine habits, and parental co-operation in the encouragement of the establishment of regular regimes and routine habits, nine items indicated significant differences in favor of Group *A*. The three instances in which no significant differences were found in favor of Group *A* were those considered to be indicative of emotional maturity.

References

1. Green, H. W. Economic status of families living in each of the census tracts. *Sheet-A-Week,* 1939, **7**, No. 1.
2. Olson, W. C., & Hughes, B.O. Subsequent growth of children with and without nursery-school experiences. *39th Yearbook, Nat. Soc. Stud. Educ.,* 1940, 237-244.

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A SIMPLE TECHNIQUE FOR MEASURING LIGHT-DARK PREFERENCE IN THE WHITE RAT*

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Conditioning of an operant (lever-pressing), with light as the source of motivation and darkness as the reinforcement, has been demonstrated in adult white rats by Keller (1) who found also that the strength of the response, in terms of latency and frequency, was related to the intensity of illumination employed. Keller used five levels of light-intensity, 1-minute periods of darkness-reinforcement, and not more than three 15-minute periods of observation daily. His findings point to the desirability of determining the expression of light-aversion (or "darkness drive") in a less restricted choice situation and over longer periods of time. The present report is of such a determination, made with a preference-apparatus that may be easily and inexpensively duplicated in any laboratory and used for classroom demonstration as well as research.

A rectangular box, 2′ x 1′ x 1′, of unpainted boards, and without a top, was suspended from above by a taut No. 16 steel wire. This wire, which was attached at its two ends to the ceiling directly above the box, passed through two small screw-eyes, one on the upper edge of each side of the box and midway between the ends, so that the unoccupied box was delicately balanced horizontally about six inches above a heavy table. Stationary uprights from this table prevented sidewise movements of the box and limited the up-down excursions of the two ends when the balance was disturbed.

As a source of illumination, a 25-watt light was placed above the exact center of the box, approximately three feet from the floor. This light could be turned off with the opening of a modified knife-switch to which was attached a silk thread leading to the upper edge of one end of the box. With the slackening of this thread the switch was closed by the pull of a small counterweight. Thus, a

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downward movement of the end of the box to which the thread was attached extinguished the light. A second thread, leading from the same place on the box, passed through a screw-eye above and thence down to a stylus, between the fulcrum and writing-point of which it was fastened. An upward excursion of the writing-point was thus determined by a downward movement of the end of the box. A counterweight pulled the stylus down with each upward movement of the box-end. The ratio of the writing-point excursion to that of the box-end was about one to two. The stylus recorded on a smoked paper kymograph drum geared to an electric-clock motor which permitted one complete revolution in six hours.

The box was divided into two square compartments by a wooden partition about two inches high which served as a low hurdle separating the "dark" from the "light" area. A drinking tube extended through a hole in the side of the box at a point about two inches above one end of this partition, and a tin food-container was fastened to the wall at each end of the box. The floor of each compartment was covered with a thin layer of sawdust, and stretched across the entire top of the box was a detachable strip of wire-mesh window screening.

In collecting the data reported herein, this apparatus was set up in a basement room in which the temperature varied between 75 and 81 degrees Fahrenheit during the course of experimentation, and in which noises from the street and elsewhere were almost entirely eliminated. Fairly complete darkness prevailed in the room except when the experimenter used a pocket flashlight in changing drum records, adjusting the stylus, and so forth.

Six male white rats, of Wistar stock, approximately 130 days old, were used as subjects. Purina Dog Chow, in granulated form, supplemented occasionally with fresh vegetables and meat scraps, served as their diet; and they were housed, when not under observation, in a dimly lighted adjoining room.

The experimental routine was as follows. The animals were placed individually in the box (usually during day-time hours) for a preliminary acclimatization period of six hours, during which no light was present but records of box movement were taken. Subsequently, for a 24-hour period, conditions were unaltered except for the onset of light whenever the animal moved into the appropriate

end of the box. Food was at all times available in each compartment and water was within reach of the animal from either side of the central partition.

It is perhaps obvious that this system of recording permits the registration of partial as well as complete tippings of the box as the subject moves about within it, and hence the possibility of records in which the presence or absence of light is not clearly indicated. Actually, however, such ambiguous records were very infrequently obtained; rarely did an animal "balance" on the partition between the compartments, and the tippings were quite generally complete rather than partial—a fact which may be related to the steadying effect of the stationary uprights with every complete excursion.

Table 1 presents the results of this prefeience-test in terms of

TABLE 1

PERCENTAGE OF TIME SPENT IN "LIGHT" COMPARTMENT BY SIX RATS DURING A 6-HOUR ACCLIMATIZATION AND DURING EIGHT SUCCESSIVE 3-HOUR PERIODS WHEN A LIGHT-DARK CHOICE WAS POSSIBLE

	Acclimatiz-ations	3-hour intervals								Totals
Rats:	(6-hr.)	1	2	3	4	5	6	7	8	(24-hr.)
1	90 5	6.8	4.4	2.4	0.0	0.8	2.0	1.2	10.4	3.5
2	11.0	6.0	1 2	1.2	0.0	0.4	0.0	6.4	13.6	3.6
3	56.8	18.8	1.2	1.2	0.0	0.0	1.2	0.4	1.6	3.5
4	98.0	8 8	7.2	1.2	0.4	2.4	2.0	3.6	2.4	3.5
5	4.8	5.2	25.0	14.8	4.4	3.2	1.6	0.4	0.4	6.9
6	10.6	1.6	2.8	0.8	2.8	1.2	4.0	0.0	0.4	1.7
Means:	45.3	7.9	7.0	3.6	1.3	1.3	1.8	2.0	4.8	3.8

percentage of time spent by each rat in the lighted end of the box during successive three-hour periods, together with the percentage of time spent in the same compartment during acclimatization. A strong preference for darkness (or aversion to light) is clearly evident in the data for each animal throughout the entire 24-hour period. In every case but one (Rat 5) this preference shows itself in the very first three-hour period after acclimatization.

In addition to confirming the earlier findings on light-aversion in the rat, these data suggest a number of other studies which might well utilize a method similar to that here described. For example, it should be possible, with minor variations in this technique, to study

the rate of conditioning and extinction of the operant involved, as well as the effect upon it of differences in light intensity, darkness-deprivation, and other factors.

Reference

1. Keller, F. S. Light-aversion in the white rat. *Psychol. Rec.*, 1941, **4**, 235-250.

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The Journal of Genetic Psychology, 1942, **61**, 167-178.

BOOKS

The *Journal of Genetic Psychology*, the *Journal of General Psychology*, and the *Journal of Social Psychology*, will buy competent reviews at not less than $2 per printed page and not more than $3 per printed page.

Conditions. Only those books that are listed below in this section are eligible for such reviews. In general, any book so listed contains one or more of the following traits: (*a*) Makes an important theoretical contribution; (*b*) consists largely of original experimental research; (*c*) has a creative or revolutionary influence in some special field or the entire field of psychology; (*d*) presents important techniques.

The books are listed approximately in order of receipt, and cover a period of not more than three years. A reviewer must possess the Ph.D. degree or its equal in training and experience.

Procedure. If among the books listed below there is one that seems important to you, you are invited to write a review of that book. It is not necessary to make arrangements with the Editor. Just send in your review. It does not matter if the book in question has been reviewed before.

(1940)

CANTRIL, H. The Invasion from Mars: A Study in the Psychology of Panic. Princeton: Princeton Univ. Press, 1940. Pp. 228.

RASHEVSKY, N. Advances and Applications of Mathematical Biology. Chicago: Univ. Chicago Press, 1940. Pp. 214.

BURLINGAME, L. L. Heredity and Social Problems. New York: McGraw-Hill, 1940. Pp. 369.

DENNIS, W. The Hopi Child. New York: D. Appleton-Century, 1940. Pp. 204.

HILGARD, E. R., & MARQUIS, D. G. Conditioning and Learning. New York: Appleton-Century, 1940. Pp. 429.

HARTMAN, G. W., NEWCOMB, T., *Editors*. Industrial Conflict: A Psychological Interpretation. New York: Cordon, 1940. Pp. 583.

DOOB, L. W. The Plans of Men. New Haven: Yale Univ. Press, 1940. Pp. 411.

HULL, C. L., HOVLAND, C. I., ROSS, R. T., HALL, M., PERKINS, D. T., & FITCH, F. B. Mathematico-Deductive Theory of Rôte Learning. New Haven: Yale Univ. Press, 1940. Pp. 329.

LANDIS, C., *et al.* Sex in Development. New York: Hoeber, 1940. Pp. 329.

THORNDIKE, E. L. Human Nature and the Social Order. New York: Macmillan, 1940. Pp. 1019.

GESELL, A., *et al.* The First Five Years of Life. New York: Harper, 1940. Pp. 393.

YOUNG, K. Personality and Problems of Adjustment. New York: Crofts. Pp. 868.

BROWN, J. F. The Psychodynamics of Abnormal Behavior. New York: McGraw-Hill, 1940. Pp. 484.

GOLDSTEIN, K. Human Natuie. Cambridge: Harv. Univ. Press, 1940. Pp. 258.
KATONA, G. Organizing and Memorizing. New York: Columbia Univ. Press, 1940. Pp. 318.
BAKKE, E. W. The Unemployed Worker. New Haven: Yale Univ. Press, 1940. Pp. 465.

(1941)

ZIPF, G. K. National Unity and Disunity. Bloomington, Ind.: Principia Press, 1941. Pp. 408.
REIK, T. Masochism in Modern Man. New York: Farrar & Rinehart, 1941. Pp. 439.
BRITT, S. H. Social Psychology of Modern Life. New York: Farrar & Rinehart, 1941. Pp. 562.
BARTLEY, S. H. Vision: A Study of Its Basis. New York: Van Nostrand, 1941. Pp. 350.
CANTRIL, H. The Psychology of Social Movements. New York: Wiley, 1941. Pp. 274.
MILLER, N. E., & DOLLARD, J. Social Learning and Imitation. New Haven: Yale Univ. Press, 1941. Pp. 341.
DEARBORN, W. F., & ROTHNEY, J. W. M. Predicting the Child's Development. Cambridge: Sci-Art 1941. Pp. 360.
FARAGO, L. (Ed.) German Psychological Waifare. New York: Committee for National Morale, 1941. Pp. 133.

(1942)

SHELDON, W. H. The Varieties of Temperament. New York: Harper, 1942. Pp. 520.
KLOPFER, B., & KELLEY, D. M. The Rorschach Technique. New York: World Book, 1942. Pp. 436.
SCHILDER, P. Goals and Desires of Man. New York: Columbia Univ. Press, 1942. Pp. 305.
MILLER, J. G. Unconsciousness. New York: Wiley, 1942. Pp. 329.
ALLPORT, G. W. The Use of Personal Documents in Psychological Science. New York: Social Science Research Council, 1942. Pp. 210.
BENDER, I. E., IMUS, H. A., ROTHNEY, J. W. M., KEMPLE, C., & ENGLAND, M. R. Motivation and Visual Factors. Hanover, N. H.: Dartmouth College, 1942. Pp. 369.
BORING, E. G. Sensation and Perception in the History of Experimental Psychology. New York: Appleton-Century, 1942. Pp. 644.
GROVES, E. R., GROVES, G. H., & GROVES, C. Sex Fulfillment in Marriage. New York: Emerson, 1942. Pp. 319.
WATSON, G. (*Ed.*) Civilian Morale. New York: Houghton Mifflin, 1942. Pp. 463.
BIBER, B., MURPHY, L. B., WOODCOCK, L. P., & BLACK, I. S. Child Life in School. New York: Dutton, 1942. Pp. 644.
HOLLINGWORTH, L. S. Children Above 180 *IQ*. New York: World Book, 1942. Pp. 332.
KLÜVER, H. (*Ed.*). Biological Symposia: Visual Mechanisms. Lancastei: Cattell Press, 1942. Pp. 322.

CRITICAL REVIEWS OF RECENT BOOKS

(*Goldstein, K. Human Nature. Cambridge: Harvard Univ. Press, 1940. Pp. 258.*)

REVIEWED BY PETER HAMPTON

The nine chapters of this book have grown out of the William James Lectures delivered by Kurt Goldstein at Harvard University during the academic year 1937-38. In a review of Goldstein's *The Organism,* which appeared in the *Journal of General Psychology,* April, 1940, the reviewer had occasion to question certain aspects of Goldstein's contention "that disease cannot be considered simply a localized disturbance in the function of circumscribed parts of the organism." Since then, results from the reviewer's observations and investigations of effects of shock on personality, have clearly indicated that the whole organism, both physiologically and psychologically is affected by disease, no matter how minor or insignificant such a disease may seem.

The changes of personality which take place in sick people will play a progressively more important part in medical diagnosis and therapeutic treatment in the future than they have heretofore. No doubt, the realization of the close relationship between the mental and the physiological aspects of human nature will bring medical men and psychologists closer together. Thus far there still seems to be a hesitancy on the part of physicians to acknowledge the close relation existing between the two spheres of approach to human behavior.

Goldstein points out that William James was one of the first scientists to emphasize the holistic approach to human nature as opposed to the atomistic one, and thus set the stage for the study of human behavior in the light of psychopathology. Today, when the very essence of human nature as it has been passed down to us is in question, a new approach from the holistic point of view becomes of vital importance.

No longer can the physician or any other scientist for that matter, isolate himself. Isolationism in the sciences is no more feasible or

safe than isolationism in politics or commerce. The "approach to man in his entirety" becomes especially important in view of the fact that our whole existence has become a jumbled-up affair. We don't know where we are going, and more important still, so many people do not even care. A fatalistic attitude seems to be spreading over modern intellectual life. The holistic approach to human nature in its various ramifications offers one of the best discernible ways out of this situation.

Besides, as Goldstein points out, "in biology action always involves the individual as a whole." Consequently, the analytic-synthetic method of approach to human behavior has to be abandoned in favor of the holistic approach. There is another reason why this must be done. In the physical sciences knowledge is not always measured by its usefulness. In the biological sciences it is. Understanding is not enough here. We must go beyond mere understanding to the practical implications involved. And how else can this be done except by considering the organism in its totality as a qualitatively organized Gestalt. Normal behavior for the field theorist is ordered behavior, while abnormal behavior, including that of the sick, is disordered.

Of course, since we are concerned with the whole organism, where one additional fact may destroy an established organization and demand a new evaluation, our knowledge in biology can never be complete; it can only be an approximation to what we are looking for. But that is to be expected. In dealing with human nature we have something intangible before us. And, as Thorndike has shown in his *Human Nature and the Social Order*, even if we know some 756 possible responses to a given stimulus, there may still be another 44 which we are unable to isolate, and so our knowledge, let alone our prediction of human behavior, will always remain somewhat incomplete.

The approach to "human nature as seen in the light of experiences with sick people" is bound to come up against two vital questions. First, is it altogether sound to go to abnormal behavior to explain normal behavior? Second, why bother with abnormal behavior in an effort to explain human actions when we can use normal behavior? There seems to be something offensive to the imagination in the idea that we must go to sick people to learn about healthy

individuals. Goldstein anticipates these two questions and answers them by saying that: First, there is nothing abstruse about abnormal behavior, that it follows definite principles like normal behavior, and therefore there is no danger whatsoever in its use to get at human nature. Second, abnormal behavior is better suited as a source of information about human nature than normal behavior, for the simple reason that there are too many disturbing factors accompanying normal behavior for its effective use in the scientific study of human nature.

Goldstein concerns himself primarily with brain lesions, and these, he thinks "are expressions of a change in the total personality of the patient." The changes that take place in personality are interesting and informative, but even more so are the adaptations of the patient to his defects. It is these adaptations that lead us to an understanding of how the normal individual reacts to his outer geographical and behavioral worlds. For instance, the pathological individual is incapable of "approaching a possible situation," that is, "a situation presented only in imagination." He "lacks an attitude toward the abstract." The only things he can grasp are those which are concrete. But, normal behavior demands a capacity to comprehend both the abstract and the concrete. It is the absence of an attitude toward the abstract in patients with brain lesions, especially of the frontal lobe, that has shown us the importance of such an attitude in normal behavior.

To emphasize the importance of the abstract attitude in normal behavior even more, Goldstein shows what speech defects, usually classed under the name aphasia, are present in individuals who lack this attitude. Of the different types of aphasia, amnesic aphasia gives us the best insight into human nature, and it is with this type that Goldstein concerns himself primarily.

Even more important than an understanding of "the consequences of the lack of an attitude toward the abstract," is "an understanding of the way in which men come to terms with the outside world." Upon the success or failure of such "coming to terms" depends not only the future well being of the individual, but life itself. If he succeeds in adjusting himself to the outside world, his behavior is ordered; if he doesn't, his behavior becomes disordered or catastrophic. The patient who finds himself in the catastrophic condition

fails in the performance, not only of tasks which cannot be performed because of his impaired capacity, but also of tasks which he should be able to carry out. The simplest activities present insurmountable obstacles to such a patient.

In themselves these findings would not mean much. But it has been found that the normal individual has to go through identical states of catastrophic behavior when confronted by some shocking situation in life. The question then arises, does the normal individual behave the same as the abnormal, or the mentally afflicted individual?

Ordinarily we react to those aspects of the environment which are of our own choosing. And as long as we are able to maintain a normal equalization between the environment and the reacting organism, everything goes well and there is ordered behavior. But when the organism is forced to react to inadequate stimuli, it falls into a catastrophic state, in which, because of the shock and general disturbance the organism has to undergo, it is often unable to react at all even with essential, but rather simple reactions such as partaking of food and drink, which keep the organism alive.

Experiences illustrating such a state of affairs can be found in many life situations. Take this case of a married couple. For years they have lived an industrious and a happy life. Then, because of some unexplainable reason, the husband makes a mistake; he kisses another woman, a mistake which the wife will not forgive. Disaster ensues with monstrous rapidity. The wife declares that she does not love her husband any longer, and demands an immediate separation. To him all this comes as a tremendous shock, and he is forthwith thrown into a catastrophic state of behavior. He agrees to every demand his wife makes, but for some time he is unable to take hold of himself. Fortunately, he still has the capacity for normal, ordered behavior, and sooner or later, if his personality is strong enough, he will win through to adequate behavior again.

Faced by such a catastrophic condition, the husband in such a situation often falls into a state of fear or even anxiety which results from fear. But this anxiety is "not a reaction to an object, but the result of the disordered functioning of the organism itself." Naturally the husband tries to escape the anxiety, but that is difficult to do, because an anxiety cannot be objectified to the extent that a fear can.

He knows that the anxiety is there, but he does not know whence it comes. Consequently his attempts at flight are pointless. He tries one thing after another in an attempt to re-establish ordered behavior, but with little success.

Fortunately, with normal individuals the anxiety state is not very often reached. And if, in our illustration, the husband does not pass from a state of fear to that of general anxiety, he can usually re-establish himself. He can face fear by making new contacts with the outside world, by recognizing the fear and overcoming it. And thus, either by attack or in some cases flight, he can forestall the inevitable anxiety-situation. In the case of anxiety it is difficult to reason out one's acts; in the case of fear, this can be done. Consequently, we find the anxiety state predominantly in the pathological individual and the fear situation in the normal individual, for, as pointed out, the mentally afflicted individual fails to comprehend the abstract, and the state of fear presupposes this capacity.

Abnormal individuals avoid catastrophic situations by escaping from them. They avoid reality and try to build up a world of their own, which shelters them from reality. With normal individuals catastrophic situations are overcome by "a fruitful coming to terms with the world." As a matter of fact, shock is a necessary accompaniment of life. Self realization can only proceed via shock and uncertainty. Progress can only be achieved through conflict with opposing forces of the environment. But this conflict must be such that man will come out of it, not through the shelter of unreality, but through "the joy of coming to terms" with the world.

What exactly does such "coming to terms with the world" imply? Both the voluntary and involuntary (instinctive) actions of the organism are directed toward the actualization of its capacities. To the extent that the individual succeeds in actualizing himself, to that extent he comes to terms with the world. The tendency of actualization is thus the motivating drive behind all action.

In some cases, pathological as well as normal, this tendency is toward maintaining the status quo, the existent state in which the organism finds itself. However, this is not the characteristic way of normal actualization. The normal tendency is not a passive, but an active one, and is directed toward progress or the catastrophic state. Real actualization and coming to terms with the outer world implies

a continual getting into catastrophic states and getting out of them again. Self actualization, according to Goldstein, is the only drive in existence, and this drive may be looked upon as identical with the needs of the organism. The satisfaction of such needs is self actualization and thus the fulfillment of the organism's desire to come to terms with the environment.

The involuntary actions or unconscious events are of special importance in motivating human behavior. They are of various kinds: The first group contains those bodily processes, automatisms, "which support and facilitate appropriate mental and bodily sets initiated by voluntary activity, and thereby guarantee the execution of performances;" in the second group we find "inner experiences," feelings, moods, desires, needs, attitudes, etc.; thirdly, we have memory, the "after-effects of earlier conscious events, which have been forgotten, but which influence our present thinking and acting." All of these unconscious, as well as conscious events play their part in assisting the individual to come to terms with his environment.

Our understanding of a person's behavior, however, is not complete unless we are able to determine the stiuctuie of his personality, and this, according to Goldstein, is comparatively constant for all time. Says Goldstein: "notwithstanding all the fluctuations of the behavior of a human being in varying situations, and the unfolding and decline that occur in the course of his life, the individual organism maintains a relative constancy." It seems to the reviewer that Goldstein is passing over the question of specificity versus consistency of traits too lightly. There is no doubt that the basic potentialities of a given personality structure or an individual organism are present at birth, but the specific directions which a personality structure will take in later life are by no means constant.

Just as the relative proportions of manic and depressive tendencies in abnormal personalities can be determined and controlled by such shock inducing methods as insulin treatment, which has been done successfully with a fairly large number of patients at the Mental Hospital, Brandon, Manitoba, so too can normal personalities be suddenly changed by severe shocks brought on by trying situations of life. It would seem then that there is more to sudden changes in personality brought on by shock than Goldstein would like to admit.

However, in spite of certain shortcomings which appear here and there throughout the book, it is probably the most readable and the best developed argument for holism in print.

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BOOKS RECENTLY RECEIVED

(There will always be two pages of book titles, listed in the order of receipt, i.e., the most recently received books will be found at the end of the list.)

Ford, C. S. Smoke from Their Fires. New Haven: Yale Univ. Press, 1941. Pp. 248.

Dearborn, W. F., & Rothney, J. W. M. Predicting the Child's Development. Cambridge: Sci-Art, 1941. Pp. 359.

Price, L. Creative Group Work on the Campus. New York: Columbia University, 1941. Pp. 437.

Reuning, K. Joy and Freude. Swarthmore, Pa.: Swarthmore College, 1941. Pp. 141.

Fitt, A. B. Seasonal Influence on Growth Function and Inheritance. Wellington: New Zealand Council for Educational Research, 1941. Pp. 182.

Sen Gupta, N. N. Heredity in Mental Traits. Calcutta: Macmillan, 1941 Pp. 207.

Angyal, A. Foundations for a Science of Personality. New York: Commonwealth Fund, 1941. Pp. 398.

Waring, E. B., & Johnson, M. W. Helping Children Learn. Ithaca: Cornell Univ. Press, 1941. Pp. 460.

Ullmann, E. V. Diet in Sinus Infections and Colds. New York: Macmillan, 1941. Pp. 185.

Hayes, S. P. Contributions to a Psychology of Blindness. New York: American Foundation for the Blind, 1941. Pp. 296.

Strong, D. S. Organized Anti-Semitism in America. Washington, D. C.: American Council on Public Affairs, 1941. Pp. 191.

Sutherland, R. L. Color, Class, and Personality. Washington, D. C.: American Council on Education, 1942. Pp. 135.

Hildreth, G. The Child Mind in Evolution. New York: King's Crown Press, 1941. Pp. 163.

Rope, F. T. Opinion Conflict and School Support. New York: Columbia University, 1941. Pp 164.

Graebner, I., & Britt, S. H. Jews in a Gentile World. New York: Macmillan, 1942. Pp. 436.

Shaffer, L. F., Gilmer, B. von H., & Porter, J. M. Experiments and Demonstrations in Psychology. New York: Harper, 1942. Pp. 230.

American Youth Commission. Youth and the Future. Washington, D. C.: American Council on Education, 1942. Pp. 296.

Hamilton, P. Hangover Square. New York: Random House, 1942, Pp. 308.

Lundberg, G. A. Social Research. New York: Longmans, 1942. Pp. 426.

Krout, M. H. Introduction to Social Psychology. New York: Harper, 1942. Pp. 823.

Hathaway, S. R. Physiological Psychology. New York: D. Appleton Century, 1942. Pp. 335.

Sorenson, H., & Lemon, A C. Workbook for Psychology in Education. New York: McGraw-Hill, 1942. Pp 178.

Bowman, H. A. Marriage for Moderns. New York: McGraw-Hill, 1942. Pp. 493.

Contributions in Honor of L. M. Terman. Studies in Personality. New York: McGraw-Hill, 1942. Pp. 333.

Morgan, J. J. B. Child Psychology. New York: Farrar & Rinehart, 1942. Pp. 588

Cole, L. Psychology of Adolescence. New York: Farrar & Rinehart, 1942. Pp. 660.

Preston, R. C. Children's Reactions to a Contemporary War Situation. New York: Teach. Coll., Columbia Univ., 1942. Pp. 96.

Bender, I. E., Imus, H. A., Rothney, J. W. M., Kemple, G., & England, M. R. Motivation and Visual Factors. Hanover, N. H.: Dartmouth College, 1942. Pp. 369.

Compton, K. T., Trullinger, R. W., & Bush, V. Scientists Face the World of 1942. New Brunswick, N. J.: Rutgers University Press, 1942. Pp. 80.

Seashore, R H., *et al.* Fields of Psychology. New York: Holt, 1942. Pp. 643.

Strain, F. B. Sex Guidance in Family Life Education. New York: Macmillan, 1942. Pp. 340.

Lewinson, T. S., & Zubin, J. Handwriting Analysis. New York: King's Crown, 1942. Pp. 147.

Burgess, E. W., Warner, W. L., Alexander, F., & Mead, M. Environment and Education. Chicago: Univ. Chicago, 1942. Pp. 66

Simmons, L. W. Sun Chief: The Autobiography of a Hopi Indian. New Haven: Yale Univ. Press, 1942. Pp. 460.

MacIver, R. M. Social Causation. Boston: Ginn, 1942. Pp. 414.

Mangam, W. D. The Clarks: An American Phenomenon. New York: Silver Bow, 1941. Pp. 257.

Allport, C. W. The Use of Personal Documents in Psychological Science. New York: Social Science Research Council, 1942. Pp. 210.

Pillsbury, W. B., & Pennington, L. A. Handbook of General Psychology. New York: Dryden Press, 1942. Pp. 400.

Miller, J. G. Unconsciousness. New York: Wiley, 1942. Pp. 329.

Schilder, P. Goals and Desires of Man. New York: Columbia Univ. Press, 1942. Pp. 305.

Hanfmann, E., & Kasanin, J. Conceptual Thinking in Schizophrenia. New York: Nerv. & Ment. Dis. Monog., 1942. Pp. 115.

Gates, A. I., Jersild, A. T., McConnell, T. R., & Challman, R. C. Educational Psychology. New York: Macmillan, 1942. Pp. 805.

Munroe, R. L. Teaching the Individual. New York: Columbia Univ. Press, 1942. Pp. 353.

Murphy, L. B., Lerner, E., Judge, J., & Grant, M. Psychology for Individual Education. New York: Columbia Univ. Press. Pp. 306.

Muenzinger, K. F. Psychology: The Science of Behavior. New York: Harper 1942. Pp. 441.

Taft, D. R. Criminology. New York: Macmillan 1942. Pp. 708.

Sheldon, W. H. The Varieties of Temperament. New York: Harper, 1942. Pp. 520.

Boring, E. G. Sensation and Perception in the History of Experimental Psychology. New York: Appleton-Century, 1942. Pp. 644.

Klopfer, B., & Kelley, D. M. The Rorschach Technique. New York: World Book, 1942. Pp. 436.

Butler, N. M. Liberty, Equality, Fraternity. New York: Scribner, 1942. Pp. 240.

McNemar, Q. The Revision of the Stanford-Binet Scale. Boston: Houghton Mifflin, 1942. Pp. 185.

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Child Behavior, Animal Behavior, and Comparative Psychology

EDITED BY
CARL MURCHISON

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AN OBJECTIVE STUDY OF THE INFORMATIONAL NEEDS OF PARENTS IN CHILD PSYCHOLOGY*

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A. INTRODUCTION

In the past two decades child psychology has so expanded that it has ceased to be a course and has become a curriculum. Because of this fact, it is often desirable to make a rigorous selection of topics and materials within the general field for special purposes. It is obvious that whenever possible such a selection should be done in terms of the needs of the particular group for whom the selection is made. It is also desirable that such material be valid and not already known. In the present study we have attempted to meet this need for a particular group.

This study attempts to determine, somewhat objectively, those facts and principles in the field of child psychology which, in the opinion of experts in the field, are the most important and most valuable for parents as well as the extent to which parents are already familiar with them. The problem, obviously, resolves itself into two rather specific tasks: First, the identification of those principles of greatest importance to parents as judged by experts, and second the testing of parents to discover the extent to which these "most important" facts and principles are already known and appreciated by them. A good deal of supplementary information concerning the parents tested is obtained and various comparisons are made between the test scores obtained by the parents and certain pertinent items in this supplementary information.

*Received in the Editorial Office on April 27, 1941.

[1]W. F. Bublitz was responsible for conceiving the problem herein investigated. He did most of the actual work of executing the study. C. W. Telford's contribution consisted of general direction and supervision while work was in progress and the preparation of the manuscript for publication. The more complete report in the form of an unpublished thesis is on file in the library of the University of North Dakota.

B. Procedure

The general procedure was as follows: First a comprehensive list of facts and principles in the field of child psychology was compiled. After considerable weeding out by the elimination of duplicates and combination of related items, the list of 160 items was rated by experts in the field as to their importance for parents. On the basis of these ratings the 40 "most important" generalizations were selected and worked up into a test of the "best answer" type. This test was then submitted to a second group of specialists in child psychology for validation. The items with the greatest validity were selected for the final test which was then administered by trained interviewers, to 300 parents. From the test results the "least known" items were finally determined. In addition to their test performances considerable supplementary data concerning the parents was also obtained. The nature of these data will be disclosed later.

1. *Selection of Generalizations*

As first conceived, the intention was to select the generalizations on the basis of frequency of mention in the body of material in child psychology to which the criteria of recency of publication, mention of the author in standard bibliographical collections, and supporting experimental evidence were applied, but it soon became evident that such a detailed procedure was not practicable. The list of generalizations finally obtained consists of a fairly comprehensive compilation from the available literature in the field.

Such a check-list necessarily has its limitation. It is not fully comprehensive; to develop such a list would be a highly laudable undertaking but it would require access to the best libraries in the country and the resources of an agency with a staff of workers. Then too, the statements have not been fully refined as to wording. The ideal wording of the generalizations could hardly be attained. In a preliminary trial it was found that it seemed preferable to state the generalizations in a brief and rather positive manner, rather than in a detailed and highly qualified way. One hundred sixty generalizations were finally obtained and listed.

2. *Evaluation of the Generalizations*

Twelve judges were asked to rank the statements on a five-point

scale with respect to their value or "importance" to parents. Items accorded first rank were marked "1"; those of least importance "5." Intermediate values were of course assigned to those generalizations of intermediate importance. The judges consisted of six nationally known specialists in the field of child psychology and the other six were general psychologists of high standing.

3. *Selection of the Generalizations for the Test*

The standard deviation plus the mean of the ratings given each item by 12 judges was used as an index for selection of items. The highest rating generalizations were selected for further consideration. Forty items were so selected for further consideration. This number was further reduced to 30 by combining those which were closely related.

4. *The Validity of the Generalizations*

In the past workers have established the validity of such generalizations by two means; by bibliographical research in which the experimental evidence for the generalizations is filed with the generalization to which it applies, and by means of the opinion of judges.

In the present study both means were employed. The items in the check list were originally selected on the basis of experimental work supporting them. The ratings by the judges on the basis of importance are likewise a check on validity. Some question may be raised as to the advisability of using one rating for two purposes, and as a matter of fact, such a procedure is seldom wise. In the present instance, however, it is doubtful whether a separate rating on validity would result very differently from the rating on importance of the items selected as most important, since a generalization can not be important if invalid. The word "validity" does not appear in the instruction to judges, most of the judges accompanied their reactions with a statement of the factors considered in giving the "importance" rating and in all cases validity was mentioned as a factor considered. The agreement of the judgments as determined by the standard deviation suggests a high degree of consistency in the factors considered by the judges in rendering a verdict on importance.

C. The Test

The test to be given to the parents was based on the "most impor-

tant" generalizations and was in the form of a "best answers" test approved quite generally as being superior to most of the other objective or "new type" tests in use today. The steps in its development will be presented briefly. The central idea dominating the construction of the items was that a generalization upon which the parent was to be tested should be presented along with others relating to the same situation and that the parent should select that generalization which to him seemed to have the highest applicability in solving similar problems.

An important point to be kept in mind is that the situations are intended to represent typical, illustrative segments of the field of parental experience in which the generalizations might apply rather than isolated problems and particular children, even though the typical characters are assigned names in some cases. The workers who did the interviewing were instructed to impress upon the parents the importance of making a decision on the basis of their general experience, observation, and reading rather than upon the basis of experience with their own children alone. Some parents had difficulty in getting this point of view as indicated by the illustrative remark, *"All of the answers might be correct depending upon the particular child,"* or *"Any of the factors named might apply or they might be cumulative in their effect."* "That is probably very true but you are asked to underline the statement which would be true in the majority of cases," were the instructions given to the workers should such objections be raised.

Where it was possible, situations were selected which represented actual problems within the experiences of everyday home life. In some cases the situations were highly general because a more concrete setting was hard to devise without suggesting the answer. Where possible too, one answer representing a supposedly common misconception was included in order to secure data on the popular misconceptions which stand in need of correction. The suggested answers were presented in a chance order as determined by putting the answers on slips of paper and assigning them to the appropriate problem in the order drawn from a box. An extra space was provided for answers which the parents cared to provide when no suggested answer seemed correct.

1. *The Validity of the Test*

The most direct way of determining whether the test measures what it purports to measure is probably to try it out on a jury of competent judges. This was done. The assumption was that if a competent judge failed to answer according to a key which indicated that answer considered best by the maker of the test, then the test required revision at the points of deviation from the key. A preliminary tryout resulted in a number of revisions. The test was then submitted to 12 additional judges for the final validation. A test-item was retained if 0.80 of the judges marked it according to the prepared key. On the basis of the final validation two additional items were deleted. This left 28 items for the final test. These are given in an abbreviated form in Table 3.

One of the writers rated 38 of the parents included in the study with whom he had contacts over a period of nine years as to their general "efficiency as parents." These ratings were later correlated with the scores they made on the test for parents. The correlation obtained was .48 ± .08. A similar rating by a second teacher who had served in the same community for 11 years gave a correlation of .36 ± .08 with the test scores. The second teacher knew nothing of the purpose of the ratings nor of the nature of the study. This indicates that scores on the test do have some relationship to actual conduct in child training. This suggests some degree of validity for the test.

2. *Administration of the Test*

The test was administered in person by workers all of whom were trained in psychology and had had considerable experience in dealing with people. Each worker was given a set of printed directions which gave in considerable detail the procedure to be followed in giving the test.

In all 300 parents were tested. One hundred of these are "city," 100 village, and 100 rural. In the city and small towns workers were met with courtesy and interest. This was not so generally true in the rural districts. It was found difficult to get returns from men and the idea of comparing the answers of men and women was abandoned because of the relatively few returns from the former. In some cases it was necessary to leave the interview guide sheet with

the parent to be filled out because of the difficulty in securing an interview. A comparison of the results from such returns with the returns from parents under supervision did not reveal any significant difference.

D. Subjects Tested

The "city" returns were obtained in Fargo and Minot, North Dakota. The villages were Enderlin (population 1800) and Hatton, (population 800). The rural returns were secured from the rural territory adjacent to Enderlin and Valley City, North Dakota.

One difficulty encountered was that of securing an unbiased sample. The difficulty was greatest in the rural district because there is no objective way of making a fair sampling. The practice was therefore followed of securing returns from all parents in the rural community so far as possible. In the small town the sampling was controlled somewhat arbitrarily by blocking the towns into districts and calling upon a given number in each district. Economic status was checked to serve as an additional criterion of sampling but little reliability can be attached to the findings on economic status as will be shown later. In Fargo and Minot several devices to control sampling were used, evidently with some success as will be shown in Table 2. From the United States Department of Commerce, Bureau of the Census, Statistics for 1930 on occupational distributions for the city of Fargo, were secured. These were not available for Minot since occupational statistics are not compiled for cities under 25,000.

It was assumed that the distribution of occupations in Minot were fairly comparable with those of Fargo so the percentages of males ten-years-old or over in each occupation was computed and compared with the number and per cent in each occupational group taking the test. As is shown in Table 1 the sampling is fairly representative so far as occupational distribution is a measure of the fairness of a sample. Enderlin is a railroad town where the average income is probably somewhat higher than in other towns of its size in the state, but that advantage is somewhat balanced by the fact that there are few college graduates among the rank and file of workers in transportation. Hatton, the other small town from which reports were collected, is in a thriving agricultural community with a fair sprinkling of high school and college graduates among the adult population.

TABLE 1

PERCENTAGE OF PARENTS IN EACH OCCUPATIONAL GROUP IN THE CITY OF FARGO AND THE PERCENTAGE OF PARENTS IN EACH OCCUPATIONAL GROUP TO WHOM THE TEST WAS ADMINISTERED

Occupational groups in Fargo according to U. S. Department of Commerce (1930)	Number in each group	Per cent in each occupational group	Per cent of parents in each grouping taking test N-100
All gainfully occupied males 10 years and over	8,224		
Agriculture	255	3.10	1
Forestry and fishing	2	.24	0
Extraction of minerals	4	.48	0
Manufacturing and mechanical industries	2,356	28.	15
Transportation and communication	1,067	13.	18
Trade	2,236	27.	29
Public service	177	2.1	7
Professional service	733	8.9	10
Domestic and personal service	588	6.7	7
Clerical	834	10.	10
Not reporting			3

Fifteenth Census of the United States: Washington, D C. Gov. Printing Office, 1931 Occupation Statistics, N. Dak., pp. 10-11.

E. RESULTS AND INTERPRETATIONS

Table 2 makes comparisons between the three sub-groups studied. The mean, standard deviation, and probable error of the mean of the entire 300 are also given.

TABLE 2

COMPARISONS AMONG THE THREE SUB-GROUPS TAKING THE TEST

Parents	Ranges in scores	Means	Standard deviations	PE Means	Diff. Means	$\frac{Diff.}{PE_{diff.}}$
City	9-23	15.67	3.03	.20	A-B= .60	$\frac{.60}{.3027} = 1.9$
Village	7-25	15.07	3.36	.22	B-C=1.69	$\frac{1.69}{.3358} = 5.03$
Rural	5-21	13.38	3.70	.25	A-C=2.29	$\frac{2.29}{.3929} = 5.82$
Total	5-25	14.70	3.10	.21		

Table 2 presents a further bit of evidence as to the validity of the test in that the performance of the city parents as measured by the mean exceeds that of the village group, which in turn exceeds that of the rural parents. This difference is in the expected direction because in Fargo and Minot there are more agencies influencing directly or vicariously parent-child relationships in a positive manner than in small towns and rural districts. Some of these are (*a*) better trained leaders for parent and teacher associations and study groups; (*b*) more agencies within the school for general adjustment of the child, such as the junior high form of organization, kindergartens, and better health supervision which in their interpretation to parents should be expected to affect the parent in a positive manner; (*c*) more public agencies which would be expected to have a similar influence, such as hospitals, child-clinics, Boy and Girl Scout organizations. The cities and small towns represented in this study were not actually surveyed for the purpose of comparing the actual difference in number and types of agencies suggested. However, ordinary observation would lead one to infer that such a survey would show a superiority for the city as compared to the small town and a greater superiority as compared to the rural districts.

The small towns represented in this report are rather progressive and prosperous, which may have a bearing upon the small difference between the mean performance of the city and village parents. Both groups made a definitely higher score than did the rural parents. This suggests the possibility of a greater need of parental education in the rural districts than in cities and towns.

Table 3 gives the percentage of correct solutions by the three groups separately and as a whole on the individual items of the test. It gives also the percentage of correct responses on each item for the experts on whom the test was tried. The table presents the items in the order in which they appear in the test and gives the generalization for knowledge of which the test-items purport to test.

The point should be kept in mind that in its use in identifying the generalizations on which parents need information, the test is intended to reveal group needs and not individual needs. The odd-even correlation for reliability was found to be .46 ± 06. The reliability of the test is thus low for individual diagnosis but is fairly satisfactory when used for group comparisons.

TABLE 3

SHOWING THE PERCENTAGES OF CORRECT SOLUTIONS BY 100 EACH OF CITY, VILLAGE, AND RURAL PARENTS ON THE SPECIFIC ITEMS OF THE TEST

Number of test-items	Generalization tested for	Per cent of correct responses City	Village	Rural	Judges
1.	The child learns by doing (derived).	48	40	42	83.33
2.	The child learns most efficiently when satisfaction attends his activities.	56	42	32	100.00
3.	The child learns more efficiently when in a state of readiness to react.	52	57	54	100.00
4.	Conditioned Reaction.	34	34	29	100.00
5.	Individual Differences exist with respect to learning.	71	69	67	100.00
6.	Meaningful material is learned more readily than meaningless.	93	92	90	100.00
7.	The young child is strikingly egocentric.	47	54	29	91.00
8.	Attitudes controlling social adjustment have their pattern established in the home.	60	57	57	91.00
9.	Performing for the child many functions he is able to perform renders him overdependent.	52	46	39	91.00
10.	Intense demonstrativeness of parental affection may entail later social maladjustment for the child.	25	25	22	91.00
11.	Children often persist in objectionable behavior because they find it a means of satisfying their wants.	75	72	65	91.00
12.	Heightened interest in the opposite sex is characteristic of adolescence.	60	61	56	91.00
13.	Anger as a social response is usually exhibited in response to opposition.	45	41	43	91.00
14.	Development takes place most readily in a rich and varied environment.	33	32	18	100.00
15.	A closer relation exists between parents and children as to ideas of right and wrong than between the children and any other group.	75	83	65	83.00
16.	All around morality cannot be taught; all that can be taught is response to situations.	20	22	29	83.00
17.	Play is an aid to adjustment to life.	94	85	85	91.00
18.	Between the ages of about two and four the child tends toward negativism more than before or later.	42	30	27	83.00
19.	The desire to be physically active is an important motive with children.	88	90	80	100.00
20.	Children are inferior to adults in seeing relationships.	35	42	37	91.00
21.	Young children readily confuse ideas of reality and imagination.	48	45	40	91.00
22.	Speech defects like stammering are most often due to social maladjustment of some sort.	45	39	42	75.00*

TABLE 3 (*continued*)

Number of test-items	Generalization tested for	Per cent of correct responses City	Village	Rural	Judges
23.	Very poor economic status exerts an unfavorable influence upon behavior.	47	49	25	83.00
24.	Facing reality is a condition of mental health.	65	76	64	100 00
25.	Attitudes of inferiority, dominance, compensation, and revenge may be symptoms of present mishandling of the child by the parents or others.	32	33	14	83 00
26.	Social adjustment is a condition of mental health.	74	66	85	91.00
27.	The child deprived of parental companionship and sympathy may develop compensatory fancies.	97	92	81	100.00
28.	Heredity provides potentialities; environment the means for attaining them.	48	35	27	100.00

*No. 22 the below the arbitrary percentage of 80 for judges is retained because one judge marked both the change from the left to the right hand and social maladjustment as factors which were about equally balanced in their influence.

Dividing the parents into environmental groups is justifiable on the ground that comparison of data may be of value in indicating relative group performance and in suggesting causes for consistent differences in trends; but in determining the generalizations upon which parents most need information it is best to consider the performance of the group of 300 parents as a whole. Curves drawn from the data (not shown here) indicate (*a*) that the trend of the results for the three groups is in the same direction suggesting common needs with respect to information; (*b*) that the number of cases in each of the three groups is too small to permit very reliable interpretation of unique group-needs (city, village, rural) since the curves are very irregular; but that (*c*) relative common needs with respect to information may be inferred from the composite curve with some assurance since it is fairly smooth.

Table 4 gives the rankings of the generalizations with respect to both information and importance and offers a third rating in terms of both. The "composite ranking" was made by simply adding the rankings of the other two columns and reranking.

To be sure, the emphasis that should be accorded can not be determined mathematically. Practically, emphasis is partly determined

TABLE 4
RANKING OF THE GENERALIZATION ON THREE BASES TO INDICATE DIFFERENCES IN EMPHASIS IN THE DEVELOPMENT OF CURRICULUM MATERIALS

Number of test-item	*A* Ranking on basis of needs (Test Results)	*B* Ranking on basis of importance to parents (Opinion)	*C* Composite rank (*A*-*B*)
16	1	10	2.00
10	2	21	10.00
23	3	2	1.00
14	4	26	15.50
4	5	12	5.50
18	6	16	8.50
28	7	6	3.00
20	8	14	8.50
23	9	18	13.50
22	10	17	13.50
7	11	28	22.50
13	12	27	22.50
1	13	4	5.50
2	14	1	4.00
21	15	25	24.00
9	16	3	7.00
3	17	15	18.00
8	18	20	21.00
12	19	7	11.50
24	20	11	17.00
5	21	5	11.50
11	22	8	15.50
26	23	23	27.50
15	24	13	20.00
19	25	24	26.00
17	26	9	19.00
27	27	19	25.00
8	28	22	28.00

by the nature of the materials themselves; some ideas may be transmitted without the expenditure of much time or words, others of possibly less importance may necessitate longer treatment. Thus the idea of the conditioned reaction (involved in testing test item No. 4) is probably more difficult to convey than the idea that anomalous behavior on the part of the child may be a symptom of present maladjustment, (No. 25) yet the latter ranks No. 1 and the former No. 4 in composite rank. The point to be made is, however, that Table 4 may be used as a rough guide in deciding the emphasis which materials should be accorded.

In devising the situations an attempt was made to include one

answer which seemed to represent a popular psychological fallacy or inadequate explanatory conception. Such an answer did not suggest itself for all situations and the procedure is, therefore, not consistent but an examination of the data suggests that some such ideas stand out because of their relatively high incidence, and represent concep-

TABLE 5
SHOWING THE PERCENTAGE OF RURAL AND CITY PARENTS WHO HELD CERTAIN INADEQUATE OR ERRONEOUS CONCEPTIONS IN CHILD PSYCHOLOGY

Number of test-item	Erroneous conceptions checked	Rural parents percent.	City parents percent.
No. 2	That depriving the child of privileges is the best means of motivating desired behavior.	26	29
No. 8	That an attitude of inferiority may be inherited.	20	21
No. 11	That emotional instability, such as crying easily, is due to prenatal experiences of the mother.	16	14
No. 12	That adolescence is not different from the earlier period in child life with respect to interest in the opposite sex.	26	27
No. 14	That "ear-mindedness" is the most dominant single causal factor in determining the number of words which the child understands when he hears them spoken.	38	30
No. 18	That the child is not more negativistic between the ages of about two and four than before or after.	62	36
No. 21	That children have more power of imagination than do adults.	36	36
No. 22	That imitation is the dominant cause of stuttering and stammering.	10	12
No. 24	Resolutely ignoring the unpleasant and looking on the bright side of life is more conducive to mental health than facing things as they are.	26	30
No. 25	That cruelty to animals on the part of older children is due to an inborn tendency to cruelty.	52	48
No. 28	Everything is possible to anyone with the right kind of environment and training.	30	22
No. 28*	Given the right heredity development must follow; the superior mind creates its own best environment.	12	11

*The above statements are numbered to correspond to the test-items in which they appear as one of the suggested answers.

tions which parents should guard against. A comparison was made between the city group and the rural group with respect to faulty conceptions and the results are presented in Table 5 for what they may be worth.

The comparison of percentages representing particular reactions in Table 5 is not very revealing so far as differences in group needs is concerned for the percentages are fairly parallel. The total number of "errors" of the types represented is somewhat higher for the rural group as might be expected from the results previously. The outstanding difference is between percentages for No. 18. This difference is possibly related to the fact that in the cities there are kindergartens and nursery-schools not found in the rural districts.

Other suggested answers which were thought to represent fairly current misconceptions did not prove to be such. Thus parents seem not to be misled in test-item No. 15 (not represented in Table 5) by the suggestion that Sunday schools were more important in determining ideas of right and wrong which children possess than are parents, nor in test item No. 17 do many parents consider play a waste of time.

With reference to the blank for answers which the parents might suggest, it may be said in general that little use was made of them by parents. Some parents who did utilize them did not add anything not suggested, with a few exceptions, and it is doubtful whether many new ideas could be gained by making a canvass of parents to secure their ideas concerning the matter of parent-child relations.

Although the test makes no claim of ideal comprehensiveness, it may have some value in serving as an inventory in study groups to determine the general level of information possessed by a group and may indicate the general direction which study should take. It may also have value in suggesting the possibilities of the general procedure employed in the development of a better test. A more comprehensive list of generalizations more highly refined with respect to validity, more nearly uniform test-items, and a broader sampling more rigidly determined would result in a measuring device of undoubted value in parent education.

F. Problems as an Index of Parent Needs

In the interview guide sheets which the interviewers used was

included a fairly comprehensive list of conduct problems. The parents were asked to check those problems which they had experienced.

The results indicate that responses of parents in checking problems are not reliable indices of parent needs. There are two reasons for this. In the first place, problems do not represent needs themselves but are symptoms of more fundamental needs on the part of parents, need of information being one of the more fundamental. In the second place, parents are not reliable in checking problems. The fact that masturbation in children appears to be almost nonexistent when as a matter of fact studies of the incidence of masturbation show rather high percentages, throws doubt on the ability or willingness of parents to admit faults in their offspring when any social stigma is attached. The junior writer is intimately acquainted with the children of many of the parents making the reports. In his experience as a public school-teacher, he has been struck by the fact that parents of problem-children often check items fewer than do those of well adjusted children. The value of the checking for this study lies in the use of the results in presenting materials in those cases where a high percentage indicates that parents recognize symptoms of maladjustment. Problems afford a good starting point in the presentation of materials, in that the teaching principle of proceeding from the familiar to the unfamiliar is thereby observed. Beginning with problems which a considerable number of parents admit they actually experience is probably superior to selecting hypothetical problems which might fall outside of the experience of a particular group.

Our data suggests one or two trends if we are justified in assuming that village and rural parents do not differ greatly in reliability in checking problems. (The rural parents were in general less frank in their general reactions.) Village parents checked fewer problems on the average than did city or rural parents, the average number being, 9.23 for city parents, 6.76 for village parents, and 8.24 for the rural group. This difference between the averages is in the expected direction. The congestion of the city with its more complex mode of living on the one hand may account for a recognition of problems in social relations in the city whereas the isolation of the country child leads to a higher incidence in problems of mental hygiene such as day-dreaming and in problems relating to the poverty of stimuli such as lack of reading material. The results suggest too that differ-

ences in incidence of particular problems may be due to the fact that parents do not distinguish carefully between their own problems of adjustment and those of the child. For example, one item which refers to laziness, shows a steep rise for rural parents. Rural life makes more family demands upon children than does urban life and rural children are probably not more lazy than urban children; there are more tasks for them to perform.

According to the returns on problems too, "gangs" seem not to represent much of a problem in the cities from which results were obtained. Both cities are progressive in child welfare activities such as Boy Scout Organizations and bands and school clubs which tend to direct the gregarious tendency of children into positive channels.

The reliability of the checking procedure is admittedly low, problems which seem to be recognized by all three groups with considerable agreement are, bashfulness, disobedience, crying too easily, fear of some sort, nervousness, temper outbursts, and teasing. In a later table it will be shown that little correlation exists between the number of problems checked and score on the test, but limiting the use of the checking to illustrative purposes is in no way objectionable and the problems which stand out as being commonly recognized with considerable agreement will justify their being given more emphasis in the development of related study materials than others not so frequently and consistently mentioned.

G. Personal Data Relating to Parents

The first pages of the interview guide-sheet called for data relating to the parents who were tested and who checked the problems. The purpose in collecting the personal data was to secure information which might throw light upon the nature of the study materials to be developed and the best way of preparing them for presentation. Some of the data called for are not utilized in this study either because returns were too incomplete or because they are irrelevant. Thus nationality, church preference, sex of parents, sex of children, club membership other than that of Parent-Teacher Associations are not considered here. They may serve as points of departure for the study of related though special problems.

Table 6 represents group-averages with respect to some of the more important items considered, and makes rough comparisons possible.

TABLE 6
MISCELLANEOUS DATA RELATING TO PARENTS OF THREE GROUPS, 100 IN EACH GROUP

	City parents	Village parents	Rural parents	Mean of Means
Mean Score	15.85	14.87	13.38	14.66
Mean Age	37.2	41.3	44.1	40.86
Final grade attained in school (Mean)	11.3	11.2	9.7	10.6
Mean number of books in home library	110	165	82	112
Mean size of family	2.8	3 16	3.49	3.15
Mean economic income	2140.00	2210.00	1690.00	2013.00
Mean number of problems checked per parent	9.39	6.76	8 24	8.13
Per cent of parents belonging to P. T. A.	50	51	18	39
Per cent having a daily paper	88	87	90	88
Per cent having at least one magazine	84	89	88	87
Per cent having a radio in the house	86	94	76	89.6
Per cent having an automobile	71	80	89	80
Per cent having had some psychology	21	31	16	22.66

Average scores on the tests have already been dealt with in detail. The variability of the measure and the reliability of the differences between averages are not computed for the other factors because the results are somewhat incidental to the major purpose of the study which is to identify common parental needs with respect to information. Differences between means are obviously too small to be significant in some cases in view of the low ıeliability of the actual checking itself. The measures of economic status is of undetermined reliability. Early in the administration of the personal data sheet it was found practically impossible to secure an estimate of present income, and workers were instructed to ask parents to make an estimate in terms of "normal times." This parents seemed glad to do, and as is generally true in such cases, it is probable that a great deal of over-estimation is involved. It is probably true, however, that this tendency to exaggerate income during normal times was fairly consistent which may give the figures some advantage over a guess as a relative index of income.

The data shown in Table 6 suggest that the materials for presentation to such groups should be in simple non-technical language. Less than 25 per cent of the parents have had any course in child-psychology and the average education of the group as a whole is about that of a sophomore or junior in high school. The finding is of course trite, but establishing the approximate educational level of a group is a desirable procedure before developing materials. Technical terminology must be avoided but there is a danger too in over-simplification, for parents are quick to resent anything which savors of "talking down." Table 6 also suggests that newspapers and magazines and radios afford a better vehicle of dissemination of information than do books while most of them do subscribe to newspapers and periodicals. A fact not shown by the mere average in the case of books is that many parents have very few books and some none at all. Averages here are misleading because of the occasional large library. It is of course true that the urban population may rely upon public libraries to a considerable extent. This fact probably is related to the finding that the village group of 100 parents owns more books than does an equally large group in the city. The point to be made is that home libraries cannot be depended upon to supply information.

Table 6 shows that less than 40 per cent of the parents tested belong to parent and teacher organizations. Relations for the education of parents cannot be placed upon that organization with any degree of assurance because it does not reach enough parents.

The chief difficulty in securing a better sample is not readily overcome. The coöperation extended by parents decreased as one went down the economic scale. Some parents from the poorest homes refused to grant interviews and the attitude of some of the poorer rural homes was such that some records showed evidence of low reliability, while some of the more prosperous parents in the villages actually asked for interviews when they were not approached. The ideal way to secure a sample would be to rate the homes on some scale such as the Whittier or Sims before making interviews. Such a procedure would require the resources of an agency with money and workers at its disposal.

H. The Influence of Certain Factors on Test Scores

Incidentally a few correlations were run between some factors con-

sidered on the personal data sheet and scores on the test. As was anticipated the values are too small to be significant in most cases, and when the factor of education is held constant they tend to approximate zero. Although the coefficients are small they are presented for two reasons.

The first purpose in presenting Table 7 is to show that the coeffi-

TABLE 7
COEFFICIENTS OF CORRELATION BETWEEN TEST SCORE AND OTHER FACTORS FROM THE PERSONAL DATA SHEETS
(For City Parents Only, N-100)

Factors	Coefficient of correlation	Probable error
Age and score	.02	.07
Size of family and score	—.14	.07
Income and score	.16	.07
Number of problems checked and score	.05	.07
Number of books in home and score	.38	.07
Final grade attained and score	.51	.05
Final grade and age	—26	.06
Final grade and size of family	—.31	.06

*The last two coefficients were computed in order to apply a partial correlation to the r for age and score and to the r for size and of family and score.

cient for education and score is definitely higher than the others. Although the r's are small their relative size has significance.

Since the reliability of the checking procedure itself is probably about the same for education and the number of books in the home, the closer relationship between education and score than for books in the home, and the closer relationship between education and score than for books and score suggest that at present general education can be relied upon more than can home libraries to raise the general informational level with reference to child-nature. It raises the question too of the possibilities of preparation for parenthood through the medium of the public school, a possibility as yet not fully explored and extended.

The size of family correlates negatively with test score though the coefficient is not sufficiently high to be very reliable, and when education is held-constant by partial correlation the value for size of family and score changes from —.14 to .03.

The correlation between the final grade and age is —.26 and is

statistically reliable as measured by its probable error. This means that the younger parent has had more education (and probably better education) than his elders in terms of number of years of schooling, and the test score correlates with education. However, age and score do not show any relationship. The apparent paradox may possibly indicate that length of experience as a parent is a factor in determining score, and that when age and score is compensated for by the greater length of experience in favor of the older parents. On this hypothesis a partial correlation was computed for age and score with education partialed out. This gives a correlation of —.11 which was in the expected direction.

The most important deductions to be made from a consideration of the personal data are that study materials should be presented in simple language and that the agencies which reach most parents are newspapers, periodicals, and radio programs. So far as can be determined, the one factor most closely related to the amount of information parents possess with respect to child psychology, is general education. No direct measure of the intelligence of parents was employed but so far as economic status and education are measures of intelligence the evidence is that intelligence is a definite factor in determining the score.

I. Contributions and Proposals

Some of the evident limitations of the study are due to the fact that the project represents a relatively new line of inquiry; the testing of parents to discover needs had not been carried out far enough by others to suggest many guiding principles at the time the study was undertaken. It is true that Laws (2), Tilson (7), and Stoddard (6) had used questionnaire and attitude tests in attempts to get at parent needs, and Ackerly (1) in 1932 carried out a study somewhat similar to the present one but dealing with a much larger field. Ackerly's study dealt with physical growth, vocational guidance, sex education, and use of money as well as with certain aspects of child psychology proper. The methods used were somewhat different, but both studies tested parents to determine needs and both used the difference between the parent's responses and the judgments of a jury of experts, to determine these needs. Pioneer work in this field seems to have been done at the University of Iowa (see Ojeman, 3 and 4; and

Pollock, 5). So far as the writers have been able to determine, this study represents the first effort to discover informational backgrounds of parents through the medium of a best answers test in which the answers suggested are in the form of a generalization. Further studies of the same kind will demonstrate the possibilities and limitations of that major procedure but it is probable that refinements in determining the validity of generalizations and in devising the test-items which embody them will result in a measuring device of definite value in parent education. The illustrative value of the major procedure as outlined in this study is our major contribution.

J. Secondary Contributions of the Study

1. The development of a list of principles and generalizations in the field of child psychology.
2. The identification of certain of the more important generalizations in child psychology on the basis of the opinion of judges. The list of "important" generalizations might be used by study groups in various manners. Program committees might make use of it in planning topics for study.
3. The development of a test of information which has validity and a reliability high enough to be used for group comparisons.

Adult education seems to be in the ascendency, especially during this period in which the federal government has taken such an interest in it. It is probable that the movement will acquire momentum and become increasingly important. The use of inventory tests such as the one here devised is highly desirable in the instruction of any group and would seem to be especially so in the case of adults because of their variability in matters of education. In other words, parents are not graded as are children in the day school, but even there inventory tests make for efficiency in instruction.

References

1. Ackerly, L. A. The information and attitudes regarding child development possessed by parents of elementary school children. Unpublished Doctor's Dissertation, Department of Child Welfare, Graduate College, State University of Iowa.
2. Laws, G. Parent-child relationships; a study of the attitudes and practices concerning social adjustment of children. *Teach. Coll., Contrib. & Educ.*, 1927, No. 283. Pp. 57.

3. OJEMAN, R. H. A standard for evaluating the validity of child development principles. *Stud. Child Wel., Univ. Iowa,* 1932, 8, 95-114.

4. ———. The construction of a curriculum in child development and family relationships. Paper read at the session on experimentation, National Council of Parent Education, November, 1932.

5. POLLOCK, J. A study of the validity of current periodical literature on child study. *Stud. Child. Wel., Univ. Iowa,* 1934, 81-218.

6. STODDARD, G. The Problem of Content in Parent Education. *Child. Educ.,* 1930, 227-232.

7. TILSON, M. A. Problems of pre-school children; a basis for parental education. *Teach. Coll. Contrib. Educ.,* 1929, No. 356. Pp. ix+90.

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THE EFFECTS OF FRUSTRATION ON NEGATIVISTIC BEHAVIOR OF YOUNG CHILDREN*[1]

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A. INTRODUCTION

The theory that negativistic behavior of young children is positively related to frustration produced by adult interference has been implied by many writers in child psychology. As the theory is usually stated, negativism is due to the child's desire to be an independent personality and his consequent resentment of adult domination. The relation of negativism to frustration has been more explicitly stated by Dollard *et al.* They attempt to account for negativism in the light of their theory that "aggression is always a consequence of frustration" (5, p. 1). Negativism is thought to be one form of aggression; it is caused by frustration produced by efforts on the part of adults to socialize the child (5, pp. 76-77).[3]

The present experiment was designed to test the theory that negativistic behavior in young children is positively related to the amount of frustration to which they are subjected. The plan of the experiment, in brief, was as follows: Measures of the amount of negativism and acquiescence and the frequency of occurrence of social contacts were obtained by means of time-sample observations, and negativism to an adult was measured by means of a series of standardized test situations. The children were then divided into two groups which were as nearly as possible equated for these variables. Children in one group were submitted to a teaching method calculated to produce mild frustration, while children in the other group

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[2]The writer wishes to express his indebtedness to his wife, who patiently and painstakingly made the observations and administered the negativism test; to Miss Evangeline Miller, head of the Princeton Nursery School; and to Misses Josephine Barton and Adeline Macloskie, the teachers who carried out the training program.

[3]For summaries of other theories of negativism, see 4 and 10.

were taught in such a manner that the amount of frustration would be somewhat reduced. During a period of such teaching the observations and tests were repeated in order to determine the effects of variation in amount of frustration on amount and kind of negativism.

B. The Subjects

The subjects in the experiment were children in the 2-4 year group of the Princeton Nursery School. This is a social service school conducted primarily for children of parents who are employed during the day. The children attend school five days a week from 8:30 until about 4:30. Lunch is provided for the children at the school. The children thus spend most of their waking hours at the school during the five days of each week.

For the most part the children came from parents of a fairly low socio-economic status. The occupations of the fathers were as follows: waiter [5], laborer [4], gardener, postman, garbage collector, and pottery worker. The father of one child was deceased. The mothers were for the most part employed in domestic work or as laundresses. The range of intellectual ability of the parents is greater, however, than is indicated by their occupations. One father, for example, who was employed as a waiter, is a college graduate and is said to be an excellent musician. The status of the mothers who were employed as domestics varied considerably, too, since some performed menial work exclusively while others were housekeepers with considerable responsibility in the running of the household.

Complete observational records and test scores were obtained from 14 children out of the class of 20. The remaining six children could not be included because illness or removal from the community prevented the completion of their study. All but one of the 14 children who made up the final group were Negroes.

C. The Observational Records

A time-sample method of observation was used in obtaining measures of the amount of negativism displayed by each child; 26 five-minute observations were made of each child in a free play situation. Observations were always made during the morning between 9:00 and 11:30. Each child was selected for observation on the basis

of his position in an alphabetical list, in order to rule out any possibility of selecting cases on the basis of their behavior at the moment. This system of course could not be followed rigidly because of absences from school. Ordinarily only one observation on a given child was made each day. In a few cases of children whose attendance was irregular it was necessary occasionally to make three or four observations on a single day; but in no case was the interval between successive observations less than half an hour. The observations in this series extended over a period of 14 weeks.

The data obtained from each five-minute observation period were recorded on a blank which was a modification of one used for a similar purpose by Caille (4) (see Figure 1). The following in-

Child ______ Date ______ In ___ Out ___ Adults ______

Time	Social contacts	Negativism	Acquiescence	Stimulus Situation						Negativistic Response											
				Adult	Child	Material	Activity	Verbal	Physical	Unclassified	Crying	Screaming and struggling	Telling the teacher	No, No	Drawing away	Running away	Hitting and pushing	Pushing material	Clinging to material	Persisting	Passive

FIGURE 1

formation was recorded on the blank before an observation was begun: the name of the child observed, the date, the school situation (indoors or outdoors), the names of adults present, and the time when the five-minute period of observation started. Each social contact and each instance of negativism and acquiescence observed during the five minutes was recorded by checking in the proper

column of the blank; and whether an adult, a child or both were involved was indicated by checks in the columns headed *adult* and *child*. If the instance recorded was one of negativism, the part of the blank opposite that entry under the heading *stimulus situation* was filled in. This information included the material involved, the activity of the child at the moment, and the verbal or physical stimulus applied to him by the other individual.

The type of the negativistic behavior was described by checking in one or more of the columns under *response*. These sub-headings were obtained by enumerating the varieties of negativistic behavior observable in children of this age and then working out a descriptive classification. The classification included the following categories: crying, screaming and struggling, telling the teacher, responding verbally ("*No, no!*"), drawing away, running away, hitting or pushing, pushing away material, clinging to material, persisting, and remaining passive. This classification proved to be quite satisfactory; only seldom was it necessary to describe the negativism in the column headed *unclassified*. The observer was of course not limited to the use of a single category. Often it was necessary to check two or more of the categories in order to describe an observed instance of negativism.

Before the record-making was actually begun, arbitrary definitions of the kinds of behavior to be recorded were adopted in order that there should be no confusion as to what constituted a social contact, an instance of negativism, or an instance of acquiescence. A social contact was deemed to have occurred whenever the child under observation stimulated another person or was stimulated by another person. Such stimulation might consist in hitting, bumping (whether intentional or not), pushing, caressing, attempting to take away a toy, making a request, giving an order, or simply making a remark to one. In cases where reciprocal responses between the two people involved followed the initial contact (as in carrying on a conversation), the instance was scored as a single social contact rather than as a number of contacts, provided, however, that the reciprocal relationship was not interrupted by one of the parties going away or occupying himself with an unrelated activity. If such an interruption did occur, a second social contact was recorded when the reciprocal relationship was resumed.

In defining negativistic and acquiescent behavior, the criteria used by Caille were adopted and found quite satisfactory for our purpose. According to Caille,

> ". . . resistant behavior included such responses as failing to obey a verbal request or command; responding to taking hold of hand and so forth by drawing away or running away; refusing to relinquish toys or material that another individual attempts to take; refusing to discontinue an activity that another person tries to interrupt; responding with retaliative measures to a physical stimulus such as pushing or hitting; and making such vocal responses as crying and saying, 'No,' 'I won't,' 'Don't,' after receiving a physical or a verbal stimulus from another person" (4, pp. 18-19).

Acquiescent behavior, according to Caille,

> ". . . included responding positively to requests and commands; allowing another person to take toys or materials with which one was playing; allowing someone else to stop one's activity; and passive overt behavior when one is the object of a verbal stimulus or a physical attack such as pushing or hitting" (4, p. 19).

When a series of negativistic responses occurred to the same situation, only one instance of negativism was recorded, unless the social contact was interrupted, as was discussed above. On the basis of these criteria, little difficulty was encountered by the observer in deciding what constituted a social contact or an instance of negativism or acquiescence.

Corresponding to each instance of negativism or acquiescence there of course had to be recorded a social contact; however, there is one exception. Occasionally a child would fail to respond to a suggestion at first, but after urging he would acquiesce. In such cases, since there was no interruption of the social contact, one instance of negativism and one of acquiescence were recorded opposite a single social contact.

D. The Negativism Test

A second method of measuring negativism used in this study involved the use of a series of standardized test situations. Some of these test situations were adapted from a similar series described

by Reynolds (10); the remainder were new tests. These tests were administered after the observation records had been completed for each child. Testing was always done in a small room containing a table and chairs of suitable size. The experimenter and the child were the only persons present. The tests were always administered during hours of the morning comparable to those of the time-sample observations. Half of the tests were administered consecutively on one day and the remainder on the following day. The experimenter who administered the tests was the same person who had made the observations during the preceding weeks. She was thus familiar to the children, although she had refrained from any personal contacts with them previous to the time of administration of the tests.

The method of approaching the child and taking him to the room for testing was essentially the same as that used by Reynolds. The procedure was as follows: A child was selected for testing on the basis of his position in the list. However, no attempt was made to test a child if he were suffering an emotional disturbance or if he were engaged in some very interesting or pleasant activity. The experimenter said, *"Come on, John, let's play some games."* The child then accompanied *E* to the testing room. *E* said, *"See the pretty blocks. Let's go over there and play with them."* The child was allowed either to sit or stand at the table, and the first test was begun after the child became interested in playing with the blocks. The children usually accompanied *E* to the testing room very willingly. This procedure was not regarded as a part of the test and was not scored.

The first test situation involved suggestions that the child build with the blocks. *E* selected four of the blocks and said to the child, *"Let's play blocks this way, John. See, I'll put a block on top, like this; now you put one on."* Meanwhile *E* made a two-block tower and then held a third block out to the child. If the child didn't accept it promptly, *E* laid it on the table before him. If the child had not started to comply with the suggestion within 10 seconds, the procedure was repeated. If after 10 seconds more the child still did not comply, *E* said, *"Come on John, let's play this way just once and then you can play your way. See, I'll put a block on top, like this; now you put one on."* If necessary this suggestion was repeated in 10 seconds, and if after 10 seconds more the child still had refused

to build, *E* went on to the next test. If the child did begin to build in compliance with any of the suggestions, *E* praised the child and then went on to the next test. In scoring this test, four points were given for compliance to the first suggestion, three points for compliance to the second suggestion, and so on. The possible range of scores was thus 0-4, with low scores indicating negativism.

The second test situation was Reynolds' "surrender" situation. *E* picked up the child without explanation and held him on her lap with her hands on the edge of the table to form a barrier to prevent his climbing down. *E* then said, *"Go ahead and play with the blocks some more."* This test was scored on the basis of length of time up to one minute that the child complied with the suggestion that he play with the blocks and the implicit suggestion that he stay on *E*'s lap. One point was given for each half minute during which the child played with the blocks and one point for each half minute that he stayed on *E*'s lap.

The third test was an imitation test. *E* returned to her position opposite the child and after getting his attention waved her right hand above her head and said, *"John, do this."* At 10-second intervals the following suggestions were given in a similar way: *"John, do this." "Come on, John, do this." "Oh, come on, John, you can do this, can't you?"* If the child complied with any of the suggestions, *E* praised him and went on to the next part of the test, omitting the remaining suggestions. This entire procedure was repeated for shaking the head slowly up and down and for clapping the hands together. The test was scored by giving two points for imitating an act in response to the first or second suggestion and one point for imitating an act in response to the third or fourth suggestion. The possible range of scores for this test was then 0-6.

The fourth test was a digit repetition test. The procedure was the same as for the preceding test except that the child was required to say numbers rather than imitate movements. The four suggestions in this case were as follows: *"John, say 'two'." "John, say 'two'." "Come on, John, say 'two'." "Come on, John, you can do this, can't you? Say 'two'."* As soon as the four suggestions were given or the child complied with one of them, *E* went on immediately to the next digit. The child was in this manner asked to say two, three, six-four, and eight-five. Scoring was the same as in the preceding test. Because

there were four parts to this test, the possible range of scores was 0-8.

The fifth test required the child to allow E to build a tower of blocks and to knock them down in accordance with instructions from E. E began by saying, *"I'm going to build something with some of the blocks over here; you can build over there if you want to."* She then built a tower of six blocks, saying, *"See, I'm going to build it up like this, and this, and this,"* etc., until the tower was completed. If the child attempted to destroy the tower, E said, *"Come on, John, let me build this,"* and if necessary began again. When the tower was completed, E said, *"See my tower? Let's knock it down, shall we? You do it."* If the child complied, E said, *"That's fun, isn't it? I'm going to build another,"* and the performance was repeated. This test was scored by giving one point for each time the child allowed E to build a tower without interference and one point for each time he complied with the suggestion to knock the tower down.

The sixth test is the last in the series given the first day. As soon as the preceding test was completed, E said, *"I'm going to build another one, and this time you mustn't knock it down, understand?"* E then built another six-block tower, then said, *"There, don't knock this one down."* Then E pretended to be occupied with writing and ignored the child for one minute. This test was scored by giving the child two points if he allowed E to build the tower without interference and giving one point for each half minute that the child allowed the tower to stand without knocking it down. Following this test, the child was returned to the group.

The child was taken to the testing room for the second series of tests on the following day in a way similar to that used in the first series. This time the room contained not only the table and chairs, but also some play materials new to the children arranged in a corner of the room. If the child was timid he was encouraged to play with the toys.

The child was allowed to play with the toys for a minute and a half. At the end of that time, the seventh test was begun. This consisted in giving suggestions that the child stop his play. E said, *"You can't play any more; come here to me."* Other suggestions if necessary were then given at 10-second intervals, as follows: *"You can't play any more; come here to me." "Come here; I said you*

can't play any more." "Come here; I said you can't play any more." Then if necessary the child was taken by the hand and brought to the table for the next test. The test was scored by giving four points for compliance with the first command and subtracting one for each command to which the child did not comply.

When the child was brought to the table he was allowed to play with some bright colored blocks for one minute; then Test 8 was begun. *E* brought out some paper and large colored crayons, saying, *"Here's some paper and some crayons. I'll take a crayon and make some marks on the paper. Now you take a crayon and make some, too."* After the child had become interested in drawing, *E* said, *"Now put the crayon in the box. We aren't going to draw any more."* Two points were given for compliance with the suggestion to mark with the crayon and two points if the child complied within 10 seconds to the suggestion to put the crayon in the box.

Before beginning Test 9, the child was given two new toys (a watch and a cup) and was allowed to play with them for one minute. Then at 10-second intervals the following four commands were given: (1) *"Give me the watch"* [or cup, depending on which the child was playing with]. *"You can't have it to play with."* (2) Same as *1.* (3) *"You can't have the ——— any more. Give it to me."* (4) Same as *3.* Whenever the child complied, of course no more commands were given. Four points were given if the child complied with the first command, and one point was subtracted for each command to which the child did not comply.

Test 10 was begun after putting away the toys used in the preceding test. The set of blocks was placed on the table before the child, and *E* built a four-block tower, saying, *"I'm going to build something with the blocks like this, like this, like this, and like this. Now you build one just like mine."* If necessary, further suggestions were given until the child attempted to build the tower. Then *E* said, *"You didn't do it right. Let me show you. . . . Now you do it."* This was repeated until the child had had four opportunities to build the tower or until the child refused to attempt another tower. One point was given for each tower that the child attempted to build.

In preparation for Test 11, all toys were removed from the table before which the child was still seated. A doll was taken by *E* and placed in a pasteboard box in front of the child, and a cover was

placed on the box. Meanwhile *E* said, *"We'll put the doll in the box. You mustn't take it out. Leave the doll in there."* Then *E* pretended to be busy writing for two minutes. One point was given for each half-minute during which the child complied with the command not to take the doll from the box.

Test 12 was begun by moving the child's chair back to the wall. The child was required to sit in the chair, and *E* meanwhile said, *"Sit down in the chair; you can't get up until I tell you to."* Then *E* went on with her writing, ignoring the child for three minutes. One point was given for each half-minute the child stayed in his chair before getting up.

E. Reliability of the Measures

The reliability of the various measures used in the experiment were estimated by computing odd-even coefficients of reliability. The coefficients of reliability, corrected by the Spearman-Brown formula, are given in Table 1.

TABLE 1
COEFFICIENTS OF RELIABILITY

Time-sample observations	
Number of social contacts	.85
Number of instances of negativism	.54
Number of instances of acquiescence	.75
Negativism test	.77

The reliability of the observational measures would be decreased either by lack of consistency on the part of the children or by unreliability in record-taking. No elaborate attempts were made in this experiment to study the reliability of the observer. However, during several days of preliminary study two observers simultaneously made records on the same children, which resulted in a fairly high per cent of agreement. The results of other studies show that observer reliability is usually not an important source of error in this kind of work (2, 4).

The reliability of the observational measures is fairly closely related to the frequency of occurrence of the type of behavior being recorded. Consequently the reliability of number of social contacts is highest. Instances of acquiescence occurred more frequently than

instances of negativism, and those observations are accordingly more reliable.

F. Equating the Groups

Complete data from the pre-training period as described above were obtained for 18 children out of the class of 20. Two children originally included were lost through their parents' removal from the community. The attempt was made to divide the 18 children into two groups in such a way that each child in one group would be matched with a child in the second group with respect to frequency of social contacts, negativism, and acquiescence as well as with respect to other factors such as race, sex, age, temperament, and home background. Perfect matches of course could rarely be made, since the group was small to begin with and no cases could be thrown out. The problem was further complicated by the loss of four more of the children through illness after the subsequent experimental work was under way. The groups consequently were not equated as well as was originally planned; but as Table 2 shows, the differences between the means of the two groups are small as compared to the variability within the groups.

TABLE 2

Pre-Training Scores for the Members of the Free and Frustrated Groups

S	Race	Sex	Social contacts	Negativism	Acquiescence	Neg. test	Age in months
				Free Group			
Carm	Negro	F	91	9	18	56	41
Eli	Negro	F	148	30	27	38	30
Hen	Negro	M	173	20	42	48	39
Jea	Negro	F	134	20	32	55	40
Ric	White	M	141	25	38	34	24
Tru	Negro	F	107	23	30	51	39
Ver	Negro	F	176	29	28	56	47
Mean			138.6	22.3	30.7	48.3	37.1
				Frustrated Group			
Wil	Negro	M	141	16	22	54	49
Car	Negro	M	202	36	59	50	39
Jan	Negro	F	173	26	35	52	41
Jean	Negro	F	168	31	39	29	33
Mil	Negro	F	91	14	27	55	29
Sta	Negro	M	127	20	34	41	29
Ted	Negro	M	124	28	15	48	36
Mean			146.6	24.4	33.0	47.0	36.6

G. The Training

The experimental variable was the amount of frustration occurring in the lives of the children during their attendance at the school. This variation was introduced through the coöperation of the regular teachers in the school.

All school experience is no doubt to some extent frustrating, to the extent that the children are taken away from the familiar routine of home and required to submit to new authority, are required to sit still and refrain from talking for certain periods of time, are often prevented from participating in interesting activities and made to pay attention to new and unfamiliar situations, and are even forced on occasion to submit to physical interference by the teacher. In the training period in this experiment, the attempt was made to introduce variations in amount of frustration from this typical nursery school situation.

The attempt was made to increase the amount of frustration occurring during the school hours of the members of one of the groups, which we have designated the *frustrated* group. This was accomplished by asking the teachers to give suggestions and directions, to interfere with activity, and to criticize to a considerably greater degree than was their usual practice. For the other group, which we have designated the *free* group, the teachers were asked to refrain as much as possible from interference with activity and from giving suggestions and criticism. The problem was presented to the teachers as an experiment designed to compare the results of "progressive" teaching with the results of old-fashioned teaching with respect to negativistic behavior, where progressive teaching was understood to involve mainly the idea of allowing each child freedom to work out independently the solutions to his problems.

The teachers, needless to say, found it difficult to carry out these instructions. It was very easy in the case of certain children to refrain from interference; but other children in the free group would persist in getting into situations which seemed to require interference. It is exceedingly difficult for experienced teachers to modify consistently their teaching methods over a fairly long period of time. However, it was felt that although the difference between the two groups in amount of frustration was not great and certainly not entirely consistent throughout the training period, nevertheless there

was a definite tendency for amount of frustration to vary in the desired direction. Some of the data reported below bear out this impression.

The training program was not carried out simultaneously on all the children in the two groups. Instead, two children from the free group and two from the frustrated group were given the special training for a sufficient time for the behavior records to be completed and the negativism test to be administered. This ordinarily required about eight school days. Then two more children from each group were trained and observed. This procedure was continued until all the available children had been studied. This staggered training procedure was used in order to reduce the number of children who were at one time being given special training, thereby enabling the teachers to concentrate on a few children rather than spread their efforts over a large group. A second reason was that this procedure would make it possible to shorten the time during which frustration was to be varied, since the observations on only four children could be completed more quickly than the observations on the whole group. The shortened training period reduced the likelihood of forming undesirable habits as a possible consequence of the experimental treatment.

H. The Second Series of Measures

There are theoretically at least three possibilities regarding the time relations between the period of increased (or decreased) frustration and the correlated behavioral changes. One possibility is that the reaction to frustration will be immediate and continuous throughout the training period. Another possibility is that the reaction to frustration will be cumulative; that is to say, the immediate reaction will be slight, but as the period of frustration is lengthened the reaction will increase in magnitude. A third possibility is that there will be adaptation to frustration; this would be evidenced by an initial reaction of maximum magnitude followed by reactions of diminishing proportions. Haslerud reports that his chimpanzees tended to adapt to frustration (8). It was observed in the present study that reactions to frustration seemed to occur very early in the training period. These reactions consisted mainly in signs of emotional upheaval, such as temper tantrums. Consequently it was

decided to begin making time-sample observations on the second day of the training period rather than to wait longer in hope that the reaction would be cumulative. The training period was continued for the length of time necessary to complete the record-taking and to administer the test of negativism.

During the training period, the records of observations were made in a way which was analogous to the method used in the pre-training series of observations, except that more observations per day were made. Instead of one observation per day, ordinarily four observations per day were made on each child, taking in rotation the four children being trained. About eight school days were usually required in order to allow time to complete 26 records on each child. Occasional departures from this schedule were of course necessitated by factors such as illness of the children.

The negativism test was administered on the last day of the training period. The procedure differed from that used in the pre-training test in that different toys were used and both parts of the test were administered on the same day rather than on different days. At least half an hour intervened between the administration of the two halves of the test. The same precautions regarding giving the test during periods of emotional upset were followed. The two parts were given on the same day in order to decrease the probability of being unable to collect a complete set of data from the child because of absence from school.

The fact that the children's training was being carried out simultaneously with the taking of the records inevitably introduced a serious complication. Given such training, the number of social contacts with adults would be decreased or increased, depending on whether the child was in the free or the frustrated group; and as the number of social contacts varied, so did the number of opportunities to exhibit negativism or acquiescence. In order to compensate in part for this error, the experimenter always informed the teachers when a given child was to be observed, and asked that the teachers refrain from special training during the five-minute observation period and try to behave toward that child in her customary manner. Such instructions doubtless were of limited value; a teacher cannot voluntarily adopt and cast off suddenly attitudes in teaching of the sort here involved. Another method of compensating for the

error, which will be discussed below, was to compare the two groups in regard to *per cent* of negativism and acquiescence rather than number of instances of negativism and acquiescence, the per cent being figured on the basis of the number of social contacts.

I. Results

In treating the results statistically, the same general procedure was used with respect to all the variables studied. This procedure will be illustrated with reference to number of social contacts.

The seven children making up the free group had an average of 138.6 social contacts recorded in the pre-training series of observations and an average of 167.6 in the training series. There is then an average of 29 more social contacts in the training series. Whether or not this difference is significantly greater than zero can be estimated by applying Fisher's t-test (7). We find that $t=1.93$ and the corresponding P (for six degrees of freedom) is approximately .10.

The seven children making up the frustrated group had an average of 146.6 social contacts in the pre-training series and 162 on the training series of observations, making an average increase of 15.4. In this case we find that $t=1.44$ and $P=.20$. Both groups tend to have more social contacts in the training series, but in neither case is the five per cent criterion of reliability satisfied.

The free group increased in number of social contacts nearly twice as much as the frustrated group. Is the difference between the two increments significant? The t-test was also used to estimate the reliability of the difference between the two groups. The free group increased 13.6 more than did the frustrated group. The t corresponding to that difference is .739, and P (for 12 degrees of freedom) is between .40 and .50. We conclude that the two groups did not differ significantly in this respect, in spite of the differences in training.

The number of social contacts was broken down into contacts with adults and contacts with children. These data were tabulated and treated in like manner. The results are summarized in Table 3.

The table shows what has already been mentioned, *i.e.,* that both groups had more social contacts during the training series than during the pre-training series. Probably this increase is a reflection of

TABLE 3
EFFECTS OF TRAINING ON NUMBER OF SOCIAL CONTACTS

		Mean increment	t	P	Difference	t	P
Number of social contacts	Free group	29.0	1.93	<.20	13.6	.74	<.50
	Frustrated group	15.4	1.44	<.20			
Number of social contacts with adults	Free group	—7.0	1.63	<.20	6.7	.89	<.40
	Frustrated group	—0.29	.05	>.90			
Number of social contacts with children	Free group	35.7	2.82	<.05	19.8	1.10	<.30
	Frustrated group	15.9	1.24	<.30			

the general social development of the children. While the free group increased more than the frustrated group, the difference is not significant. In number of contacts with adults, the free group decreased while the frustrated group was practically unchanged. The fact that there is a difference between the two groups, even though it is not a significant one, indicates that the teachers were unable to follow completely their instructions to desist from special training methods during the actual making of records. The fact that there was a fairly marked drop in adult contacts with the free group and practically no change in adult contacts for the frustrated group suggests that it was easier for the teachers to reduce frustration for the free group than for them to increase frustration for the members of the frustrated group.

The free group increased in contacts with children sufficiently to satisfy the five per cent criterion of significance, while the frustrated group increased less than half as much. This increase on the part of the free group is probably simply the result of greater freedom from restrictions imposed by adults. Another possible explanation is that children compensate for loss of contacts with adults by making more social contacts with children.

Table 4 summarizes the effects of training on negativism. In this case, instead of comparing the groups with respect to number of instances of negativism, they were compared with respect to per cent of negativism. It was found that negativism and acquiescence correlated with social contacts to the extent of .74 and .69 respectively. Negativism and acquiescence probably vary with number of social

TABLE 4
EFFECTS OF TRAINING ON NEGATIVISM

		Mean increment	t	P	Difference	t	P
Per cent of negativism	Free group	—2.3	1.18	<.30			
	Frustrated group	1.0	.63	<.60	3.3	1.31	<.30
Per cent of negativism to adults	Free group	—7.9	4.84	<.01			
	Frustrated group	—3.3	0.85	<.50	4.6	1.09	<.30
Per cent of negativism to children	Free group	—0.1	.05	>.90			
	Frustrated group	2.5	1.25	<.30	2.6	.89	<.40
Negativism test score	Free group	2.71	1.98	<.10			
	Frustrated group	—2.57	.55	>.60	5.28	1.03	<.40

contacts because a greater number of social contacts furnishes more opportunities for a child to be negativistic and acquiescent. One result of the training procedure, as we have seen, was to produce variation in number of contacts. The per cent of negativism was therefore used in order to control the factor of opportunity for exhibition of this type of behavior. The per cent was computed for each child by dividing the number of instances of negativism by the number of social contacts. In the case of negativism to adults and to children, the divisors were of course the number of contacts with adults and with children.

The results of the study of negativism are in general in the direction which would be predicted on the basis of the theory that negativism is a type of aggression which results from frustration. The free group in general decreased in per cent of negativism, while the frustrated group increased in per cent of negativism. The reaction of the frustrated group seemed to be negativism to children rather than to the adults who were responsible for the increased frustration; they became less negativistic to adults but somewhat more negativistic to children. This point will be discussed later.

The results of the standardized test situations also were in agreement with the hypothesis, since the free group got on the average a higher score (indicating less negativism) while the frustrated group showed a decrease.

Differences between the two groups were too small and variability within the groups too great to yield evidence of statistical significance of the differences between the groups on any of these variables.

Table 5 is a similar summary of the results dealing with acquies

TABLE 5
EFFECTS OF TRAINING ON ACQUIESCENCE

		Mean increment	*t*	*P*	Difference	*t*	*P*
Per cent of acquiescence	Free group	—1.7	1.63	<.20	3.3	.90	<.40
	Frustrated group	1.6	.45	>.60			
Per cent of acquiescence to adults	Free group	4.1	.88	<.50	3.1	.50	>.60
	Frustrated group	7 2	1.75	<.20			
Per cent of acquiescence to children	Free group	1.2	.66	>.50	1.5	.52	>.60
	Frustrated group	—0.3	.01	>.90			

cent behavior. The differences were too small throughout the table to yield probabilities small enough to indicate significance. Both groups became somewhat more acquiescent to adults and showed but little change in per cent of acquiescence to children.[4]

Negativism is of course not a unitary psychological trait. Children may refuse to comply with suggestions for a multiplicity of reasons and in a multiplicity of ways. In an attempt to reduce the data to categories which were perhaps more meaningful psycho-

[4]It will be noticed that the free group showed a slight decrement in per cent of total acquiescence, although the same group increased in per cent of acquiescence both to adults and to children. This inconsistency came about through the use of a certain method of tabulation. In a small proportion of the cases, social contacts were made which could only be described as involving a group rather than a single person. In case the group was made up of an adult and one or more children, checks were made on the record blank opposite that contact under both *adult* and *child.* Such cases were tabulated both as acquiescence to adults and acquiescence to children. Consequently the sum of the denominators of the fractions used in computing per cent of acquiescence to children and per cent of acquiescence to adults was greater than the denominator of the fraction used in computing the per cent of acquiescence in general. Because of this discrepancy (as well as because of errors involved in averaging percentages based on different numbers of cases) *per cent of acquiescence* is not equivalent to the mean of *per cent of acquiescence to adults* and *per cent of acquiescence to children.* This statement applies as well to the results presented in other tables.

logically, the varieties of negativistic behavior which had been used on the record blank were classified under three headings: negativism of a submissive or withdrawing type, aggressive negativism, and verbal negativism. Five of the varieties were classified as negativism of a submissive type; these were *crying, drawing away, running away, telling the teacher,* and remaining *passive.* Five other varieties were classified as aggressive negativism; these were *hitting or pushing, pushing away material, clinging to material, screaming and struggling,* and *persisting.* The one other type was verbal negativism. This category did not include *telling the teacher,* but only verbal negativism directed toward the person involved in the stimulus situation.

The changes in per cent of negativism of each type are shown in Table 6. Per cent of negativism of a given type was computed by

TABLE 6
EFFECTS OF TRAINING ON TYPE OF NEGATIVISM

		Mean increment	*t*	*P*	Difference	*t*	*P*
Per cent of submissive negativism	Free group	—12.0	3.73	<.01	16.6	2.22	<.05
	Frustrated group	4.6	.69	>.50			
Per cent of aggressive negativism	Free group	—13.7	1.48	<.20	0.2	.02	>.90
	Frustrated group	—13.9	2.29	<.10			
Per cent of verbal negativism	Free group	19.3	2.87	<.05	8.7	.75	<.50
	Frustrated group	10.6	1.12	<.40			

dividing the number of times that type of negativism occurred by the total number of instances of negativism. Since opposite a single instance of negativism several of the varieties of negativistic behavior were often checked in order to describe fully that event, the per cent of negativism of the three types will add up to more than 100 per cent.

As is indicated in the table, the free group decreased in the withdrawal type of negativism by 12 per cent, which is a great enough change to satisfy the one per cent criterion of significance. The frustrated group, on the other hand, increased by 4.6 per cent. The difference between the groups, 16.6 per cent, satisfies the five per cent criterion of significance.

The amount of aggressive negativism decreased about 14 per cent in both groups. Training apparently did not affect this variable, since there is only a chance difference between the groups. In verbal negativism the difference between the two groups is somewhat greater. While the free group increased 19.3 per cent (a significant change) the frustrated group increased about half as much, 10.6 per cent. The difference between the groups was, however, not significant.

According to the hypothesis that negativism is a form of aggression resulting from frustration, it might have been predicted that the frustrated group would decrease in submissive negativism and increase in aggressive negativism, while the free group would perhaps exhibit the converse effect. Instead, we find that the frustrated group increased in submissive negativism and the free group decreased in submissive negativism, while both groups decreased considerably in

TABLE 7

EFFECTS OF TRAINING ON TYPE OF NEGATIVISM TO ADULTS AND TO CHILDREN

		Mean increment	t	P	Difference	t	P
Per cent of submissive negativism to adults	Free group	20.4	1.21	$<.30$	18.8	.93	$<.40$
	Frustrated group	1.6	.14	$>.80$			
Per cent of aggressive negativism to adults	Free group	—20.2	1.00	$<.40$	28.8	1.25	$<.30$
	Frustrated group	8.6	.77	$<.50$			
Per cent of verbal negativism to adults	Free group	—6.1	.57	$>.50$	1.2	.10	$>.90$
	Frustrated group	—4.9	.78	$<.50$			
Per cent of submissive negativism to children	Free group	—9.0	2.24	$<.10$	16.0	2.48	$<.05$
	Frustrated group	7.0	1.34	$<.30$			
Per cent of aggressive negativism to children	Free group	—10.5	1.08	$<.40$	8.3	.76	$<.50$
	Frustrated group	—18.8	3.64	$<.02$			
Per cent of verbal negativism to children	Free group	16.6	3.07	$<.05$	5.4	.54	$>.50$
	Frustrated group	11.2	1.32	$<.30$			

aggressive negativism. There is some evidence that the increase in submissive negativism on the part of the frustrated children may have occurred at the expense of verbal negativism, which normally is on the increase in children of this age and which actually did increase considerably in the children in the free group.

When the data for types of negativism are further broken down into the two categories of negativism to adults and negativism to children, they become too scanty to be of any great value, especially in the case of negativism to adults, which was much less frequent than negativism to children. Nevertheless the results of these breakdowns are presented in Table 7.

Relatively few of the differences in Table 7 are significant. Those that do satisfy the five per cent criterion are in the same direction as the differences reported in the preceding table. It is interesting to note that there is no evidence of displaced aggression on the part of the frustrated children. On the contrary, the frustrated children decreased in aggressive negativism to children (significantly so) and increased in submissive negativism to children. The increase in negativism to children mentioned previously is thus accounted for by an increase in a submissive type of behavior rather than by aggressive behavior.

J. Discussion

The fact that there was rather wide variability in the children's reactions to variations in amount of frustration is easily understandable. The inconsistency in the training which has already been mentioned is no doubt one important reason. Not only did the training of a single child tend to be inconsistent, but there were also differences in the rigor with which frustrations were applied to different children. Frustrating situations which are objectively the same are furthermore not equivalent in their frustrating effects on different children. Personality differences, differences in feelings of security, or differences in frustration tolerance result in the possibility that situations which are superficially alike may produce quite different effects in different children. As a consequence of these considerations, it is not surprising that the children did not exhibit uniform reactions to the experimental situation.

The authors of *Frustration and Aggression* (5) consider the well-

known peak in negativism which occurs at about three years of age as evidence of aggression resulting from frustration caused by feeding problems, cleanliness training, etc. However, their theory in the case of this experiment would probably not lead to a prediction that increased frustration would produce negativism of the aggressive type, at least not towards adults. According to the theory, tendencies to overt aggression are inhibited by punishment or anticipation of punishment; the overtness of the aggression varies with the amount of punishment anticipated as a consequence of the behavior (6). Acts of aggression in the schoolroom are ordinarily pretty effectively discouraged by the teachers, which might make increased negativism of the aggressive type unlikely. This would be especially true in the case of aggressive negativism to adults.

According to the theory, when aggression is inhibited, it tends to be expressed in modified forms or directed against the self. Self-directed aggression is unlikely unless all other forms of aggression are strongly inhibited by anticipation of punishment (5). In this experiment we might then expect the aggression to be expressed in a modified way. A likely hypothesis seems to be that the aggression against adults would be displaced to the other children in the class; but we find on the contrary that the frustrated children *decreased* in aggressive negativism to children. Alternative possibilities might include substitute behavior (any action which reduces to some extent the strength of the original instigation) or some other form of modified aggression. The varieties of negativism which we have classified as submissive negativism (crying, drawing away, running away, etc.) may represent modified aggression. If they are so considered, it is possible to reconcile the findings of this study with the frustration-aggression theory, since the free group decreased and the frustrated group increased in total submissive negativism and in submissive negativism to children. Data pertaining to substitute behavior, self-aggression, or aggression other than aggressive negativism are unfortunately not available. Nor do we have any information regarding any modification in aggressiveness that may have occurred outside the school situation.

Barker, Dembo, and Lewin found that a result of frustration in their experiment was a regression in the constructiveness of play (1). The slight differences between the two groups in our experiment

in verbal negativism may also represent a regression in behavior as a consequence of frustration. In children of this age, verbal negativism is normally beginning to increase markedly (4). The children who made up the free group in this study increased nearly twice as much in verbal negativism as did the members of the frustrated group.

K. Summary

This experiment was designed to test the theory that amount of frustration resulting from adult interference is positively related to the amount of negativistic behavior exhibited by young children. Measures of the frequency of social contacts and instances of negativism and acquiescence in nursery school children were obtained by means of a time-sample method of observation. Negativism to an adult was measured by means of a series of standardized test situations. The children were divided into two groups which were equated for these variables. Children in one group were submitted to a teaching method calculated to produce mild frustration, while the children in the other group were taught in such a manner that frustration would be somewhat reduced. During this period of training the observations and tests were repeated in order to determine the effects of the variation in amount of frustration on amount and kind of negativism. The following conclusions may be drawn from the comparison of the pre-training scores with the scores obtained during the training period:

1. The free group decreased somewhat in total amount of negativism as measured by the time-sample observations, while the frustrated group increased slightly. The free group decreased significantly in negativism to adults and was unchanged in negativism to children. The frustrated group decreased slightly in negativism to adults and increased slightly in negativism to children. Differences between the groups were not statistically significant.

2. As measured by a series of standardized test situations, the free group decreased in negativism to an adult while the frustrated group increased. The difference between the groups was not significant.

3. The free group decreased significantly in negativism of the submissive type, while the frustrated group increased. The differ-

ence between the groups was great enough to satisfy the five per cent criterion of significance.

4. Both groups decreased considerably in aggressive negativism. There was only a chance difference between the groups.

5. The free group increased significantly in verbal negativism, while the frustrated group showed a smaller increase. The groups did not differ significantly.

6. There is no evidence that the frustiated children exhibited displaced aggression by showing more aggressive negativism toward children. On the contrary, the frustrated children decreased significantly in aggressive negativism to children.

References

1. Barker, R., Dembo, T., & Lewin, K. Experiments on frustration and regression in children. *Psychol. Bull.*, 1937, **34**, 754-755.
2. Bott, H. McM. Method in Social Studies of Young Childien. Toronto: Univ. Toronto Press, 1933.
3. Britt, S. H., & Janus, S. Q. Criteria of frustration. *Psychol. Rev.*, 1940, **47**, 451-470.
4. Caille, R. K. Resistant Behavior of Preschool Children. New York: Bur. Publ., Teach. Coll., Columbia Univ., 1933.
5. Dollard, J., Doob, L. W., Miller, N. E., Mowrer, O. H., & Sears, R. R. Frustration and Aggression. New Haven: Yale Univ. Press, 1939.
6. Doob, L. W., & Sears, R. R. Factors determining substitute behavioi and the overt expression of aggression. *J. Abn. & Soc. Psychol.*, 1939, **34**, 293-313.
7. Fisher, R. A. Statistical Methods for Research Workers. London· Oliver & Boyd, 1928.
8. Haslerud, G. M. III: Some interrelations of behavioral measures of frustration in chimpanzees. *Char. & Person.*, 1938, **7**, 136-139.
9. Lewin, K. A Dynamic Theory of Personality. New York: McGraw-Hill, 1935.
10. Reynolds, M. M. Negativism of Pre-School Children New York: Bur. Publ., Teach. Coll., Columbia Univ., 1928.
11. Rosenzweig, S. The experimental measurement of types of reaction to frustration. In Murray, H. A., *Explorations in Peisonality*. New York: Oxford Univ. Press, 1938.
12. Sears, R., Hovland, C., & Miller, N. Minor studies of aggression: I. Measurement of aggressive behavior. *J. of Psychol.*, 1940, **9**, 275-296.

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I. A GENETIC STUDY OF SUSTAINED VISUAL FIXATION AND ASSOCIATED BEHAVIOR IN THE HUMAN INFANT FROM BIRTH TO SIX MONTHS*

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A. INTRODUCTION

The fundamental importance of the problem of the development of visual space perception in psychology has long been recognized. The nativists and empiricists have waged a long and bitter war about the problem. Gottschaldt, a foremost genetic psychologist of our age, regards it as the "nucleus problem of all psychological development" (16, p. 147). Basic to this problem of primitive visual space perception and its development is the knowledge of the oculomotor responses of newborn infants, because these responses are not only the foundation upon which adult visual space perception is gradually built, but they are also among the earliest complex behavior patterns to become organized and functional in the infant's adaptation to his environment.

Much literature has been published on the problem in question. However, most of these writings represent casual observations which have yielded highly variable and often contradictory results. This

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A complementary study of the development of successive fixation is in preparation.

[1]The writer wishes to express her gratitude to Dr. Arnold Gesell for making available to her the resources for the investigation at The Clinic of Child Development, Yale University School of Medicine. His interest and constructive criticism throughout the experiment are deeply appreciated. She is greatly indebted to Professor H. M. Halverson for inspiration, encouragement, and advice both at the time of active research and during the preparation of the manuscript. She also wishes to thank Mr. Paul Hartmann, Technician, who assisted substantially in the construction of the apparatus. Finally she wishes to express her appreciation to Miss Elizabeth Munger, the Superintendent, Dr. Jane E. Oltman, the Resident Physician, and the nurses in charge of the infants at the Connecticut State Farm for Women, for their cooperation in providing subjects, assistants, an experimental room, and very comfortable living quarters for the writer.

lack of agreement among the observers is probably due to variations in technique used under uncontrolled or, at best, inadequately controlled conditions and to differences in objective and terminology. While it is not the purpose of the present study to review these observations, mention should be made of two experiments, Guernsey's (17) and McGinnis' (1), which are exceptional in that they represent careful research under well controlled conditions.

Guernsey's study centers its interest in the developmental changes in the size of the pupil, the curvature of the lens, and the coördination of the right-left movements of the eye with chronological age. McGinnis' investigation deals primarily with the types of eye movements exhibited by very young infants in response to rotating bars. The present experiment, as a complement to these two studies, aims to investigate oculomotor responses, in early infancy, to a black disk moving in a vertical plane against a uniformly white background.

In selecting this experimental set-up the present research attempts to fulfill a fourfold purpose:

1. To study the nature, occurrence, and development of sustained visual fixation[2] of a stimulus object which recedes and approaches in front of the subject's eyes.

2. To determine the various types of eye movements involved in the fixation.

3. To analyze the postural responses of the infant during the fixation.

4. To investigate other related phenomena in the fixation.

B. Apparatus

The apparatus consists of five principal parts: (*a*) an experimental cylinder with its accessories, (*b*) an experimental crib, (*c*) a stimulus object, (*d*) a system of illumination, and (*e*) a motion picture camera (see Figures 1, 2, 3, and 4).

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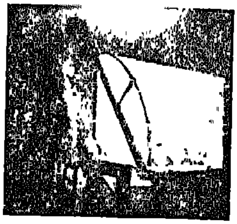
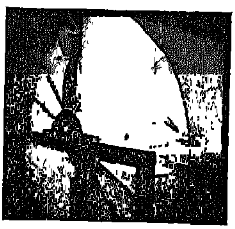
[2]Visual fixation is generally defined in adult human psychology as the directing and relative immobilizing of the eye so that the object "looked at" lies on the visual axis, its image falling upon the fovea. In dealing with human infants, the subjective aspect of visual fixation is obviously unascertainable. However, its objective aspect, as revealed by the postural set of the fixating eye, is accessible to careful observation; and it is to this ocular postural set that we are referring when we use the term "visual fixation." In sustained visual fixation the relative immobilization of the eye is particularly pronounced.



Showing the experimental cylinder mounted on its heavy wooden base, the device for locking the cylinder in position, and the camera through the viewer of which the experimenter observes the behavior of the infant prior to setting the camera in action.

FIGURE 1 PHOTOGRAPH OF THE EXTERIOR OF THE APPARATUS



Showing the infant lying in the experimental crib inside of the experimental cylinder and fixating the descending stimulus disk against an indirectly illuminated and uniformly white background.

FIGURE 2 PHOTOGRAPH OF THE INTERIOR OF THE APPARATUS

FIGURES 1-2

1. *The Experimental Cylinder*

The experimental cylinder is made of a double layer of 18-mesh wire screening inside and 2-mesh .04 gauge wire netting outside. It is mounted on a firm square wooden base, and so supported on a bearing at each end as to rotate freely on its horizontal axis. It is 48 inches long, 36 inches in diameter, and 2 inches above the floor. It is closed in by one-way-vision wire screens and supported by wooden spokes at both ends. Its surface is further strengthened by four small wooden braces placed 90° apart, and extending the length of the cylinder (see Figures 1 and 3).

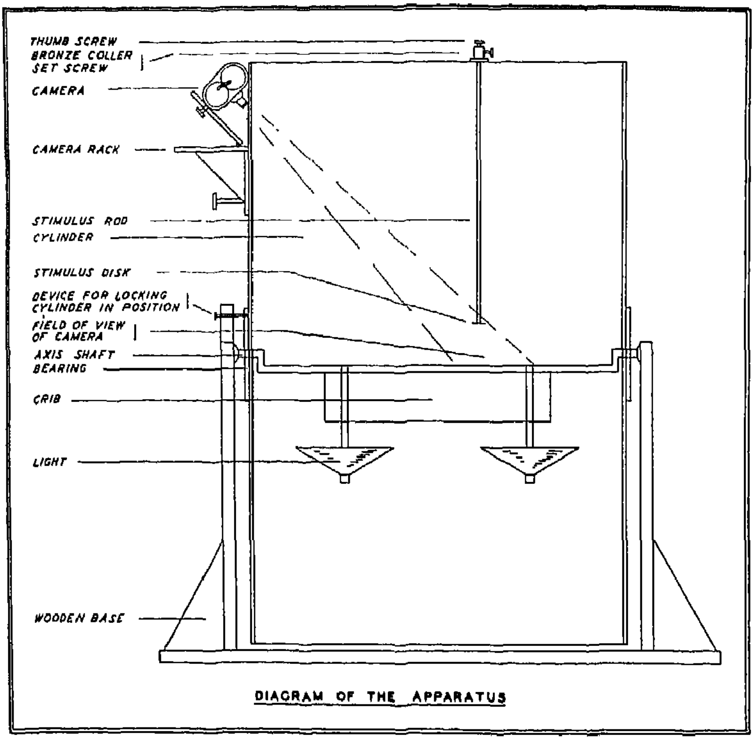


FIGURE 3

A heavy wooden block, containing a large number of pinholes closely arranged in a semi-circle, is mounted on the wooden base at the foot end of the cylinder slightly above and beyond the horizontal axis (see Figure 4). By inserting a stout steel pin through one of these holes into a depression in the wooden framework of the cylinder, the latter can be locked in position at any point of its rotation.

Two 90° sectors of scieen at the foot end of the cylinder are detachable, thus providing two separate doors through either of which the subject can be introduced into the experimental cylinder or removed from it. (Compare Figure 1 which shows the experimental cylinder with the doors in place and Figure 2 which shows the cylinder with the doors detached.)

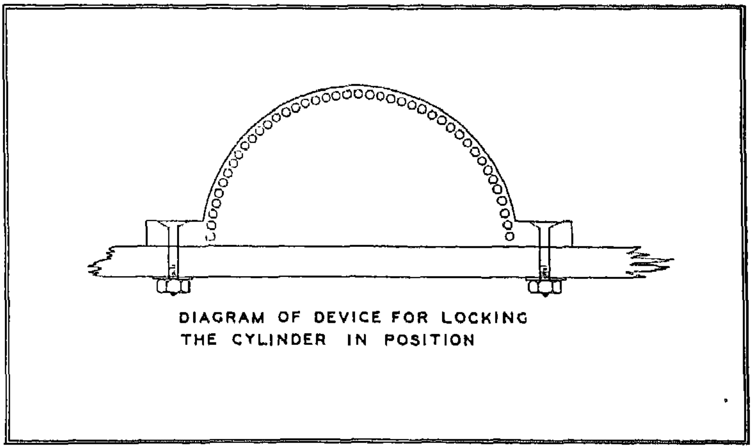


FIGURE 4

2. *The Experimental Crib*

In the center of the experimental cylinder, and attached to the axis shaft around which rotate the bearings supporting the cylinder, is a specially designed experimental crib, 30 x 20 x 8 inches in dimension. The crib is composed of a stout wooden framework and a heavy canvas body. It can be slid back and forth along its framework. The inside of the crib is heavily padded to provide a comfortable but firm resting surface for the subject. The head end of the crib is narrowed and tilted downward slightly by proper padding in order to confine the subject's head within the field of view of the camera without impeding at the same time its free movements, as well as to prevent the infant's forehead from obstructing a full vision of the stimulus during ocular fixation. Three pairs of soft but strong straps are placed strategically along the length of the crib to fasten the infant into the crib and thus to insure his safety during the experiment (see Figures 2 and 3).

Both the crib and the entire interior of the experimental cylinder are painted a flat white for two purposes: (*a*) to create a one-way-vision effect on the apparatus, and (*b*) to provide a uniform and contrasting background for the black stimulus object.

3. *The Stimulus Object*

The stimulus object is a black disk of sheenless velveteen. It is

two inches in diameter, and is attached to a bronze rod: length, 36½ inches; diameter, ½ inch. The disk is situated within the experimental cylinder in direct line of vision of the subject. It can be raised or lowered at will by manipulating the bronze rod from the outside of the cylinder through a hole into which the rod is inserted. The hole is located in one of the four braces at a point 19⅛ inches from the head end of the experimental cylinder. Directly above the hole on the same brace is mounted a three-inch bronze collar with a 9/16 inch lumen and a set-screw attachment. The sole function of the collar is to insure a constantly perpendicular relationship between the rod and the cylinder by providing a passage for the former through its lumen; the set-screw allows the rod to be set at any distance from the subject as the occasion demands. A thumb screw at the free end of the rod serves to safeguard the latter from slipping through the collar and the hole. The entire length of the rod is graduated in half-inch units. When completely lowered the stimulus disk at the end of the rod is three inches from the bridge of the subject's nose. When completely raised it is 36 inches away (see Figures 2 and 3).

4. *The System of Illumination*

The interior of the experimental cylinder is illuminated by four No. 1 panchromatic photoflood electric lights which are arranged in pairs on both sides of the experimental crib. They are located 9 inches from the sides of the crib, 9 inches from the ends of the cylinder, and 5½ inches below the level of the crib. They are separately wired and provided with Kodaflectors. Together they give a uniform and indirect illumination of 90 foot candles at the zenith of the inner surface of the cylinder. The intensity of the illumination diminishes imperceptibly until it is 75 foot candles at the horizon (see Figures 2 and 3).

5. *The Motion Picture Camera*

Along the vertical diameter of the foot end of the experimental cylinder two spokes are enlarged and modified to serve as an alignment track for a camera rack. The latter is provided with a platform upon which is mounted a Bell and Howell Filmo camera. The camera can be set at any level and at any angle by means of a system

of set-screws. It is equipped with a 2-inch F 3.5 lens and Eastman Super XX Panchomatic Safety Film; it is set at a constant distance of 46 inches from the bridge of the subject's nose; and it operates at a speed of 16 exposures per second. The angle of view of the camera includes the subject's head, shoulders, and upper chest (see Figures 1 and 3).

C. Procedure

The infant, when wide awake, dry and contented, is brought fully clothed from the nursery and placed in a waiting crib just outside the experimental cylinder. He remains there until he becomes accustomed to the illumination used in the experiment. Then he is gently lowered into the experimental crib, and the straps are fastened snugly around him. Following this the crib is slid into position and the door of the cylinder closed. Directly afterwards the cylinder is rotated to a position determined by the spontaneous head posture of the subject such that the stimulus disk, when completely lowered, will be in front of and very slightly above the bridge of the infant's nose, equidistant from the two eyes.

The disk is held in this position until the subject directs his regard to it. In order to do this he has to elevate his chin very slightly and raise his upper eyebrows and lids. (With very young infants jiggling of the rod and patient waiting on the part of the experimenter are frequently necessary before this initial visual regard can be "captured.") As soon as the subject begins to fixate the disk, it is slowly moved, at about two inches per second, away from the eyes until it has travelled all the way to the 36-inch mark and all the way back to the starting point. In this presentation of the stimulus disk care is taken that the infant continues to fixate. At the first sign that the regard is being diverted, the movement of the disk is immediately suspended. It is continued only when the subject renews his fixation. (With very young infants such renewal can be brought about only by much jiggling of the rod and patient waiting on the part of the experimenter.)

With infants who are able to keep their heads in a mid-position throughout the experiment, the starting point for the stimulus is the 36-inch mark. In every other respect the procedure remains the same. This slight modification is introduced to prepare those

infants for a second experiment[3] to be reported in a later publication.

Under ordinary circumstances all of the four lights in the experimental cylinder are turned on during the experiment. However, with infants less than one week of age, the amount of light used has to be substantially reduced to avoid undue stimulation of the eyes. Thus, in the case of newborns no artificial light is used, as a rule, during the first day or two. Later, two lights at the back of the infants' heads are turned on. Finally, at about two weeks of age, all four lights can be turned on without causing the immediate protective closing of the eyelids.

Cinema records are taken of the ocular and head behavior of the subject during the experiment in about one-fourth of the total number of observations. At all times protocols are kept concerning the infant's general physical condition, reaction time, postural responses, and other related phenomena in visual fixation.

Observations are made once every day with infants below two weeks of age. Beginning with the third week the experiment is performed once every other day. This is continued until the infant has given perfect performance in both experiments—undiverted regard in the first, and successive fixation of all the 18 disks in the second—or until he has reached the age of 24 weeks.

D. Subjects

The subjects are 25 healthy, full term infants from the Maternity Hospital of the Connecticut State Farm for Women, Niantic, Connecticut. They range in age from 7 minutes to 24 weeks. Nineteen of the children are white, and the remaining six, colored. While no formal measure is taken to ascertain their intellectual endowment,

[3]Experiment II investigates the nature, occurrence, and development of *successive* visual fixation in the human infant from birth to six months. The general experimental set-up is the same as in Experiment I, except that the black stimulus disk is now presented in a double-alternation pattern (right—left—left—right—right, etc), at a constant distance of 36 inches, instead of at a varying distance in a fixed meridian. The disk appears in turn at each of 18 windows arranged 6.66° apart in an arc which subtends 180° on the inner surface of the experimental cylinder. It appears first 3.33° to the *right* of the direct line of vision of the supine infant, whose head occupies a mid-position. Then it appears 3.33° to the *left* of the direct line of vision. The distance between the two successively exposed stimulus disk increases regularly and symmetrically until a separation of 175.34° is reached.

it is evident from their general behavior that physiologically and emotionally they are normal infants who adapt themselves quickly and successfully to the experimental set-up. These subjects begin their participation in the experiment at different age levels as follows: 11, immediately or very shortly after birth; 2, before two weeks of age; 12, after 3½ weeks of age or older. The entire study lasted 10 weeks.

D. Treatment of Data

1. *Cinema Records*

The cinema records are analyzed both as sequences of ever changing behavior patterns and as isolated units in each sequence by means of an Eastman Model *D* projector equipped with a 1-inch lens. This projector can be driven either by motor or by hand. The former device is used to study behavior sequences; the latter, behavior units. A Veeder-Root counter attached to the projector translates footage into seconds and fractions of a second. Stilled cineographic frames of infants are projected at twice the life size on a white paper-covered wooden screen, placed at a distance of 33⅛ inches from the lens.

Different types of oculomotor responses to the stimulus disk are studied by determining, with the aid of a metric ruler, the positions of the irises in relation to each other and to the rest of the exposed parts of the eyeballs in each of a series of frames in which a given oculomotor response takes place. The size of the palpebral fissures and its variations are studied by the same method.

Rotations of the head on its vertical axis are determined by comparing individual cineographic frames with a set of photographs depicting head rotations of 10°, 20°, 30° 40°, 50°, 60°, 70°, 80°, and 90° to the left or right of the mid-position. This enables the experimenter to make an accurate approximation of the degree of any given head rotation. Abductions of the head to left or right are measured with the aid of a protractor, 9½ inches in diameter and graduated in 10° units. By paralleling the base line of the protractor with that of the crib in the cineographic frame on the screen, and then by placing the protractor between the experimenter's eyes and the frame in such a way that the pointer on the protractor

bisects the nose and mouth of the image of the subject, the degree of abduction of the head can be closely approximated. Flexions and extensions of the neck are comparatively of less frequent occurrence in supine infants. Furthermore, the degree of this type of head movements is greatly obscured by the factor of foreshortening which creeps inevitably into the cineographs; therefore, no measuring device has been constructed for it. Blinking is most effectively studied by hand-cranking the projector while observing the film closely, counting the blinks as they appear on the screen.

2. *Protocols*

The protocols include the name, case number, age, sex, and nationality of each subject; the date, time, and duration of the experiment; the infant's general physical condition, reaction time, quality of performance, postural responses, and other related phenomena in visual fixation; and the nature, duration, and frequency of the diverted regards and their places in the total oculomotor response to the stimulus object. The primary purpose of the protocols is to supplement the more exact but less inclusive cinema records.

3. *Combined Data*

When all the cinema and protocol data have been analyzed in detail, they are combined in the final case-by-case and age-by-age analyses. The former provides for a longitudinal study of the results and is therefore particularly useful in tracing developmental traits and tendencies. The latter provides for a statistical approach to the available data, thus revealing group trends and characteristics at given ages. Both types of analysis furnish a wealth of material on individual differences in oculomotor responses in early infancy.

E. Results

Altogether 410 observations have been made with the 25 subjects. Protocol records have been kept for all of these observations. In addition, cinema records, totalling about 1,100 feet of film, have been kept for 88 of these observations. These data have been analyzed and compiled under four main headings: (1) Stages of Development in Sustained Visual Fixation; (2) Oculomotor Responses; (3) Postural Responses; and (4) Other Related Phenomena.

TABLE 1

STAGES OF DEVELOPMENT IN SUSTAINED VISUAL FIXATION

Stage No.	Name of stage	No. of cases	No. of obser-vations	Median age at entrance of each stage	Age range
I	Absence of Fixation	4	4	41.5 min.	7 min.–1 hr. 15 min.
II	Dawning of Fixation	8	40	20 hrs.	8 hrs.–2 wks. 2 das.
III	Sustained Near-fixation	11	52	5 das.	9½ hrs.–3 wks. 3 das.
IV	Pre-perfect (Variable) Fixation	18	77	3 wks. 5 das.	5 das.–20 wks. 3 das.
V	Perfectly Sustained Fixation	24	117	4 wks. 4½ das.	5 das.–22 wks. 6 das.
VI	Post-perfect (Roving) Fixation	10	22	7 wks. 4 das.	2 wks. 3 das.–23 wks. 6 das.
	Unclassified	24	95		6 das 24 wks.
	Negative reaction due to overbright illumination	2	3		1 wk. 3 das.; 1 wk. 6 das. (N); 3 wks. 4 das. (O)
	TOTAL		410		

1. *Stages of Development in Sustained Visual Fixation*

Analysis of all available data reveals six stages of development in sustained visual fixation under the present experimental conditions (see Table 1 and Figure 5).

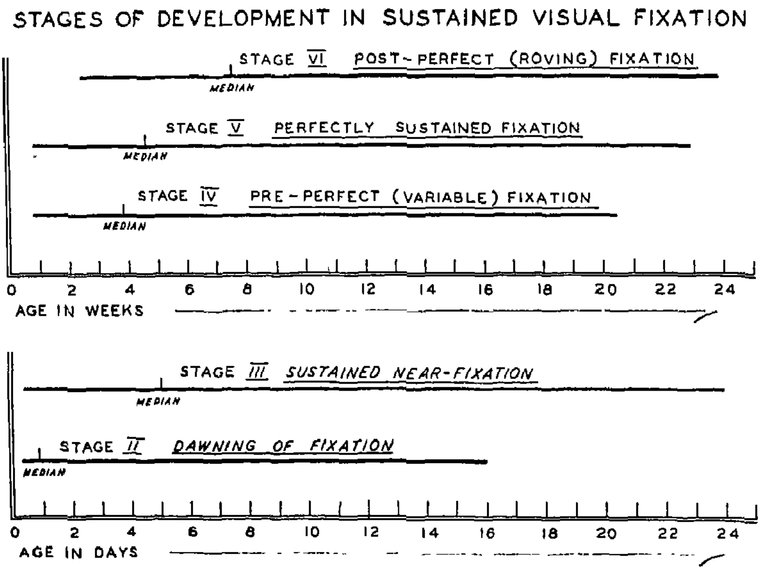


FIGURE 5

a. Stage I. Absence of Fixation. The eyes are wide open. The pupils rove around incoördinately without being able to fixate the disk. There is not one moment when the pupils are actually immobilized. Occasionally the infant stares in the direction of the stimulus object, but the expression of the eyes is passive and blank, lacking the lustre and animation characteristic of an actively fixating eye. Furthermore, there is a conspicuous absence of the postural concomitants of true fixation under the condition of the experiment, viz., the slight elevation of the chin, the uplifting of the upper eyelids and eyebrows, and the wrinkling of the forehead.

The head, the limbs, and, to a less extent, the trunk are in constant undirected motion. Sucking sounds are frequently audible. These movements are not temporarily inhibited or even modified by the presence of the stimulation.

b. Stage II. Dawning of Fixation. Entrance into this stage of development is evidenced by the presence, for the first time, of the following characteristic behavior patterns:

(1). The checking, or at least the substantial modification, of most or all sporadic bodily activities.

(2). The inhibition of negative reactions, such as crying and whimpering, if present.

(3). The slight raising of the upper eyelids and eyebrows which, in turn, increases appreciably the width of the palpebral fissures.

(4). The slight wrinkling of the forehead.

(5). The slight elevation of the chin.

(6). The bringing of the fixating eye or eyes in line with the stimulus disk for brief periods of time. The regard is fleeting and sporadic, but is nevertheless unmistakable.

(7). The relative immobilization of the eyeball or eyeballs and the absence of any movement extensive enough to throw the eyes off the direct line of vision of the stimulus object, although side-to-side and up-and-down movements of the pupils are sometimes present when the disk is within a very close range.

(8). The ability of the eye or eyes to fixate the stimulus disk *all* the way, both during its withdrawal and its approach. However, the regard is decidedly unsustained.

c. Stage III. Sustained Near-fixation. In this stage of development the infant fixates the stimulus disk with an active, keen, and sustained regard when it is at a close range; and with brief, feeble, and sporadic glances when it is farther away. The line of demarcation between the two zones apparently is not fixed, and is farther removed from the infant during the retreat of the disk than during its approach. As the infant grows, this line of demarcation recedes gradually until it goes beyond and therefore disappears completely from the 36-inch distance, which is the limit of the visual field in the present experimental set-up.

In this "conquest of space" by vision, the progress made by the eye is characterized by daily fluctuations. One day the infant makes a fresh gain of 5 or 10 inches; the next day he shows no improvement or maybe even some regression. However, the final outcome is a complete mastery by the infant of the distance prescribed by the present experimental condition.

d. Stage IV. Pre-perfect (Variable) Fixation. In this developmental stage the infant fixates the disk both during its withdrawal and its approach with an intense, absorbing, and sustained gaze which is, however, not entirely free from diverted regard or regards. These diverted regards may occur anywhere in the experiment and may last for any lengths of time. Their presence is occasioned by widely divergent factors. These factors may be involuntary and so beyond control; such as, a violent sneeze or a deep yawn. They may be strong urges on the part of the infant to rotate from one position to another, to play with his fingers, or to look overhead. They may be the result of the infant's general physical condition; such as drowsiness or a lack of strength to maintain the fixation through the entire experiment. They may be simply a lack of sufficient interest in the disk to follow it through. Whatever may be the cause or causes, these diverted regards are not occasioned by the infant's inability to see as far as the 36-inch distance.

e. Stage V. Perfectly Sustained Fixation. This stage is characterized by active, intense, and well-sustained regard of the stimulus disk throughout the entire course of its withdrawal and its approach. Fixation in this case may be monocular or binocular. The infant may occupy a mid-position or assume a partial or complete tonic neck reflex attitude. His body may be tense or relaxed. He may be very still or quite motile. However, the main distinguishing feature of the stage, the undiverted and intense visual fixation, is invariably present.

f. Stage VI. Post-perfect (Roving) Fixation. In contrast to the immediately preceding stage in which sustained visual fixation of the stimulus disk has reached its peak, this period is characterized by the decline of interest on the part of the infant in the visual fixation of the same stimulus object. Instead of gazing at the disk with the steadfast, intense, and undiverted regard, he now fixates it intermittently, sporadically, or not at all. He is apt to be either somewhat cross or deeply absorbed in some other form of activity. No longer satisfied with merely gazing at the disk which has apparently become too simple for him, he will occasionally appear to institute a game of his own with the stimulus object: he will fixate it recurrently and in rapid succession in order to obtain a series of contrasting visual sensations—dark, bright, dark, bright, etc.

Superficially this stage resembles Stage IV, but it has a significant distinguishing characteristic: visual fixation actually becomes less and less prolonged as the time goes on, probably because the infant is now more competent and is outgrowing the immaturity of sustained fixation.

The above classification of developmental stages is based on 315 of the total 410 observations (see Table 1). This leaves unclassified 95 observations which appear to belong to the Pre-perfect (Variable) or to the Post-perfect (Roving) Fixation stage, but which occur between the first and last perfect reactions in ten infants, and after the first and only perfect reaction in four subjects (Cases *A*, *B*, *H*, and *L*).

These observations resemble those classified under Stages IV and VI in that the diverted regards are not occasioned by the infant's inability to see as far as is required by the experiment; yet, unlike either of the two groups, they do not as a *group* show improvement or decline in the development of sustained visual fixation. Considered singly, many of these observations undoubtedly belong to the Pre-perfect (Variable) Fixation stage and many others belong to the Post-perfect (Roving) Fixation stage. However, there are still others which defy being classified into either category. Taken as a whole, these 95 observations would seem to be reflections of the complex integrative development of human vision.

In connection with the above-described stages of development in sustained visual fixation, it is important to note the following facts:

1. There is no hard-and-fast line separating any one of these developmental stages from any other. On the contrary, one stage blends into another quite imperceptibly as the child grows. A subject who has exhibited unmistakable signs of having outgrown a certain stage may very often revert to it for a day or two before he continues his development in the subsequent stage.

2. Several very outstanding individual differences are demonstrated: (*a*) The age level at which a particular stage of visual development is reached varies considerably from infant to infant. (*b*) Not all infants progress through all the six developmental stages. The number and kind of stages exhibited vary a great deal with individual infants. (*c*) The relationship between the length of time required by each infant in reaching a given stage and that

required by the same infant in outgrowing the same stage reveals very significant "type" differences among infants. Taking the behavior of the subjects in relation to Stage V (Perfectly Sustained Fixation) as an example, some infants become skilled in sustained visual fixation very quickly and remain so for a long time. Some acquire the ability with equal rapidity but soon appear to become bored with the experimental situation. Some require a long time to become proficient and retain the proficiency for a long time. Some take an equally long time to reach the stage but soon outgrow it. Still others occupy a median position in the development of the skill and are fast, medium, or slow in losing it.

3. Some of the individual variations are due to the limitation of sampling.

2. *Oculomotor Responses in Sustained Visual Fixation*

a. Eye postures and movements of fixation.[4] During sustained fixation of the stimulus disk the fixating eye is never absolutely steady. It makes constant side-to-side and up-and-down excursions. These movements are so minute that they often escape the notice of an untrained observer even in cinemanalysis. For this reason, whenever the word "immobilize" appears in the text, it is used in the *relative,* and not absolute, sense.

As pointed out by Berens (3), these minute movements of fixation cause the fovea to traverse the different parts of the stimulus object, and thus enable an image to be built up on the retina. Furthermore, they prevent the fovea from overexposure. As a result, exhaustion is avoided and the ability to perceive the stimulus object continuously is maintained.

Beginning with the second stage in the development of sustained visual fixation, the process of true fixation is gradually evolving. The first step in this development is frequently monocular fixation. In this step the fixating (active) eye, which the infant places in direct line with the stimulus object by appropriate head movements, opens more widely than the non-fixating eye, and is immobilized except for adaptive shifting of the conjugate deviation variety, which will be discussed in the following section. The non-fixating (resting) eye

[4]See Tables 2 and 3.

TABLE 2

DEVELOPMENTAL STEPS IN EYE POSTURES AND MOVEMENTS OF FIXATION

Step No.	Name of step	No. of cases	No. of obser- vations	Median age for entrance into each step	Age range
I*	Monocular Fixation	4	6	28.5 hrs.	9.5 hrs.–1 wk 2 das.
II	Monocular Dominance	14	38	3 wks. 5 das.	32 hrs.–12 wks.
III	Alternation of Dominance	15	46	8 wks. 6 das.	2 wks. 3 das.–23 wks.
IV**	Binocular Fixation	23	69	7 wks. 2 das.	1 wk. 4 das.–24 wks.
	Modified Binocular Fixation	3	4		13 wks. 2 das.–20 wks. 6 das.
	TOTAL		163		

*This step apparently varies a great deal among the infants both in the time of its first appearance and in its duration. The number of cases in this step would doubtless have been greater if more cinema records of oculomotor responses of the subjects during the first hours after birth had been available.

**Inclusion in this developmental step of a larger number of cases, particularly of several precocious cases, brings down markedly the median age for entrance into the step.

TABLE 3

CORRELATION BETWEEN STAGES OF DEVELOPMENT IN SUSTAINED VISUAL FIXATION AND DEVELOPMENTAL STEPS IN EYE POSTURES AND MOVEMENTS OF FIXATION

Stage No.	Sustained visual fixation		Eye postures and movements of fixation
I	Absence of Fixation		
II	Dawning of Fixation	I	Monocular Fixation
		II	Monocular Dominance
III	Sustained Near-fixation	I	Monocular Fixation
		II	Monocular Dominance
		III	Alternation of Dominance
IV	Pre-perfect (Variable) Fixation	III	Alternation of Dominance
		IV	Binocular Fixation
V	Perfectly Sustained Fixation	III	Alternation of Dominance
		IV	Binocular Fixation
VI	Post-perfect (Roving) Fixation	IV	Binocular Fixation

Note: The above table shows only a very rough correspondence. There are many exceptions and much overlapping on both sides.

is generally closed or partly open, is not in direct line with the stimulus disk, and often wanders about independently.

The second step in the development of visual fixation is monocular dominance. In this step the dominant eye, which the infant places in direct line with the stimulus object by appropriate head movements, behaves very much the same as the fixating eye in the preceding step. However, the subordinate eye, instead of being closed or wandering independently, now shifts as far as possible to its nasal corner in order to be at least partially in line with the stimulus disk, and is relatively immobilized for the duration of the fixation. Nevertheless, it does not shift in accordance with the distance of the disk. In other words, the dominant eye leads in the fixation process, while the subordinate eye merely coöperates.

In the step just described either the left or the right eye is consistently dominant in a given experimental sitting. Now ocular fixation enters the third developmental step in which monocular dominance alternates rapidly and rhythmically between the two eyes. This is accomplished by the rhythmic rotation of the head—left and counterclockwise (abduction left), right and clockwise (abduction

right), etc., or left and clockwise, right and counterclockwise, etc.

Directly following the third step, or sometimes coincidentally with it, is the fourth and last step in the development of visual fixation; namely, binocular fixation. This step is generally, though not invariably, characterized by binocular convergence. When this capacity first appears, it is carried out by a series of small globus jerks. As the stimulus disk approaches, no immediate adaptive ocular movements are observed. Then a succession of spasmodic movements of the pupils toward each other alternate with relatively long intervals of ocular inactivity. Finally when the disk comes within a close range (3-4 inches), not infrequently strabismus sets in—an overcompensation in accommodation for near vision. The infant will then blink violently to free himself from this apparently highly uncomfortable state.

As the infant grows, the process of convergence in response to the approaching stimulus disk becomes smoother and smoother until it occurs, in all appearances, as a continuous process such that even a frame-by-frame cinemanalysis fails to reveal the beginning or the end of any one of the component ocular movements.

Binocular convergence is of several varieties or degrees. In its most ideal form it is symmetrical; i.e., the angle and magnitude of convergence in each eye correspond exactly to the angle and magnitude of convergence in the other eye. This occurs only when the two eyes are equidistant from the object of fixation. However, in most of the actual experiences, even under our rigidly controlled experimental condition, the infant tends to place his head in such a way that one of his eyes is slightly nearer the stimulus object than the other. In such a case binocular convergence is more or less asymmetrical, the degree of asymmetry corresponding very precisely to the difference in distance between each of the eyes and the stimulus disk. The eye which is farther away from the disk converges proportionately more than the one which is nearer. In extreme cases, one of the eyes stations itself practically directly in front of the object of fixation. Consequently, it shifts little or none at all as the stimulus object approaches and recedes from it, while the other eye does all the shifting. In such an instance, binocular convergence hardly exists, even though binocular fixation is there.

In addition to these four types of eye postures and eye movements

mention must be made of a special kind of ocular fixation which appears to be a variety of monocular dominance, but which is so often employed by older infants in whom binocular convergence is already functioning regularly that it requires special consideration. In this type of ocular fixation the infant places his head in such a way that the stimulus disk is neither between the two eyes nor directly in front of one; rather it is slightly to one side of both eyes. In order to respond adaptively to such a situation, the eye which is nearer the disk shifts adaptively, as the disk approaches and retreats, while the more distant eye remains converged during the entire fixation process. This appears, on the surface, to be simply a case of monocular dominance. However, if one considers that in monocular dominance the dominant eye is in direct line with its object of fixation, and also that an infant employing monocular dominance is generally incapable of binocular convergence, one is then inclined to feel that the present case—in which the stimulus object is not directly in front of either eye, and in which the fixating eyes are capable of convergent relationship under normal circumstances—is not an instance of monocular dominance in its original primitive form. Rather it is a modified form of binocular fixation, modified in order to adapt successfully to the peculiar situation to which the fixating eyes are subjected.

Of course, one can argue from the standpoint of its strong resemblance to monocular dominance that the case in question is simply an instance of reversion to a more primitive form of behavior. However, since one finds similar cases in older children and even in adults, the writer favors the explanation just proffered.

b. Other types of eye movements involved in sustained visual Fixation. In the preceding section descriptions have been given of minute movements of fixation and of movements of binocular convergence. There are, however, two other types of eye movements involved in sustained visual fixation. The first type has been mentioned on three different occasions in the above section; the second type has so far not been touched upon. They are conjugate deviation and coördinate compensatory eye movements.

(1). *Conjugate deviation.* Conjugate deviation, or the deflection of the eyes in the same direction at the same time, is an ocular phenomenon that becomes functional very early in the life of the human infant. In the present study the earliest cinema record avail-

able, of Case *J* at 32 hours of age, shows this phenomenon in full operation. It probably comes into existence at an even earlier date. In sustained visual fixation conjugate deviation is employed in two very important functions; namely, ocular fixation of three different types—steady monocular dominance, alternations of dominance, modified binocular fixation, and exploratory reactions. In the preceding section some detailed descriptions have been given concerning the relative positions of the eyes in each of the three types of ocular fixation in question. From these descriptions it is plain that conjugate deviation of the adversion-abversion type is widely and consistently used for ocular fixation in two or three of the developmental steps in eye postures and fixation movements.

Aside from its use in sustained visual fixation, conjugate deviation is employed to explore the contour of the stimulus object when the latter comes within a close range. Results of the present investigation show conclusively that as the disk comes within a distance of about one foot from the eyes, conjugate deviations of small magnitudes and of all types—adversion-abversion, elevation and depression, both vertical and oblique—occur in rapid succession. The extent of these movements seems to be in strict conformity with the contour of the disk. Such movements gradually drop out as the disk withdraws beyond the one-foot distance.

It is perhaps important to point out that in the adversion-abversion type of conjugate deviation, the eye which is nearer the object of fixation deviates to a less extent than the eye which is farther away. In the elevation and depression types, the magnitudes of deviations are amazingly similar in both eyes.

(2). *Coördinate compensatory eye movements.* Coördinate compensatory eye movements have been defined by Dodge as "those eye movements by which the constant fixation of an unmoved object of interest is maintained during rotation of the head" (11). In the present study the earliest cinema record available, of Case *J* at 32 hours of age, shows the presence of coördinate compensatory eye movements at this age level. The writer again favors an even earlier existence. However, our results also indicate that these eye movements do not become truly efficacious until the fourth and fifth weeks of age. During the first three weeks of life coördinate compensatory eye movements are effective only for head movements of

very low velocity and very limited scope. With three of our 13 noenates, even very slow and very restricted head movements result occasionally in the infants' losing sight of the stimulus disk, a conclusive evidence that in these three subjects coördinate compensatory eye movements are present only in a rudimentary degree during the first three weeks of their lives.

By the fourth and fifth weeks coördinate compensatory eye movements have undergone a considerable amount of improvement in the human infant so that head movements of moderate velocity and excursion, such as those used in alternation of ocular dominance, can take place without causing diverted regards. By the seventh and eighth weeks quite abrupt and extensive head movements can take place without detrimental effect on the infant's performance. From then on the improvement continues, but perhaps not with such amazing rapidity.

Because coördinate compensatory eye movements invariably involve both eyes, and also because they are movements of the eyeballs on their vertical axes, they are conjugate deviations of the adversion-abversion type. However, they possess, at the same time, four important characteristics which distinguish them from all other forms of eye movements. These are as follows:

1. The eyeballs shift in the opposite direction to that of the spontaneous shift of the head.

2. The average degree of shift of the two eyeballs corresponds amazingly well with the degree of the shift of the head. There is no measurable error.

3. The shift of the eyeballs takes place simultaneously with the shift of the head. There is no interval between the two movements.

4. The eyeball which is nearer the direction in which the head moves shifts further than the eyeball which is farther away from it.

3. *Postural Responses in Sustained Visual Fixation*

Postural responses in sustained visual fixation are important because in human infants, just as in the young of many lower animals, visual fixation is by no means confined to oculomotor reactions. It is a function involving all parts of the body. For the sake of convenience the present discussion is divided into two parts: Attitudinal Patterns and Postural Activities.

a. Attitudinal patterns in sustained visual fixation. It is a repeatedly observed fact that the tonic neck reflex attitude (*t-n-r*) in which the infant lies on his back with his head averted to one side, usually the preferred side, his face-arm extended, and his contralateral arm flexed, is the spontaneous waking attitudinal pattern of the normal infant in the first three months of life. The present experimental set-up does not alter the essential form of this pattern, but it does seem to shorten substantially the duration of its manifestation. Results from 13 neonates show that the complete right *t-n-r* is definitely broken up at the mean age of 3 weeks 5 days (range: 1 week 6 days–12 weeks), and that the complete left *t-n-r* is abandoned at an even earlier date, viz., at the mean age of 2 weeks (range: 5 days–3 weeks 6 days). The present experimental condition likewise hastens the assumption of the partial left, of partial right *t-n-r* and of the mid-position. Results from 16 very young infants show that the partial left *t-n-r* is first assumed at the mean age of 6 weeks (range: 3 weeks–12 weeks 4 days), and discarded at the mean age of 6 weeks 2 days (range: 3 weeks–13 weeks 2 days); that the partial right *t-n-r* is first assumed at the mean age of 4 weeks 4 days (range: 1 week 2 days–17 weeks 5 days), and discarded at the mean age of 5 weeks 3 days (range: 2 weeks 1 day–17 weeks 5 days); and that the mid-position is first assumed at the mean age of 4 weeks 1 day (range: 2 days–11 weeks).

This earlier displacement of complete *t-n-r* by more mature waking attitudinal patterns is probably due to an important item in the present experimental set-up; namely, the position of the stimulus disk just prior to the experimentation. Our procedure requires that at the beginning of each observation the experimental cylinder be rotated, before the infant is introduced into it, to its initial position, with the disk occupying a mid-position directly above the head end of the experimental crib. Many of the subjects usually see the disk as they are being placed in position in the crib, and before the experimenter can begin to present the stimulus object, these subjects are already busily fixating it. In their moment of being powerfully attracted by the disk, they very frequently refrain from averting the head to the preferred side, if they are at all capable of doing so; although it is quite obvious that were the disk not there, they would

assume spontaneously, from the start, a complete *t-n-r* in preference to a partial *t-n-r* or a mid-position.

Another interesting observation regarding attitudinal patterns in sustained visual fixation concerns the classification of the subjects on the basis of their preferences in these attitudinal patterns. Of the 13 infants who begin their participation in the experiment before two weeks of age, one (7.69+ per cent) prefers consistently a left *t-n-r,* three (23.08— per cent) prefer consistently a right *t-n-r,* six (46.15+ per cent) prefer a right *t-n-r* in an overwhelming majority of the cases, and the remaining three (23.08— per cent) show no conclusive preference for either side.

While these statistics probably are not representative of the general distribution of posture preferences in very young infants among the population at large, they at least suggest the possible number of types of attitudinal patterns preferred by human infants and the amazing consistency in the preferences.

Finally, the correlation between eye dominance and attitudinal preference, as shown by the results from 12 of the subjects in the present study, is of interest. Of these 12 infants, three (25 per cent) are consistently homolateral, seven (58.33+ per cent) are consistently contralateral, and the remaining two (16.67— per cent) are inconsistent.

b. Postural activities in sustained visual fixation.

(1). *Oral activity.* In a previous study of form discrimination in human infants, the present writer found conclusive evidence that oral activity plays an active and constructive rôle in the infant's discrimination of geometric forms (19). The question is now raised as to whether or not oral behavior participates in sustained visual fixation. The data upon which the following generalizations are based are derived exclusively from our 88 cinema records, totalling about 1,100 feet of film. As a result, the information relative to the problem in question is far from being complete. For this reason, a positive finding in this case is much more significant than a negative one. With this point in mind we are in a position to examine the following observations.

In at least 10 of the total 25 cases, it is found that in general the mouth is partly open during active visual fixation and closed

during diverted regards or passive disinterest. It is wide open when the infant becomes intensely interested or pleasantly excited at the sight of the disk.

In at least 11 of the infants, the mouth participates actively in visual fixation through variations in the shape and size of the aperture and in the degree of tenseness of the lips, in conjunction with changes in the magnitude and direction of the fixation movements of the eye and the head.

In at least 11 cases sucking, "chewing," or swallowing movements are repeatedly observed during visual fixation. Since no immediate objects of mouthing, such as thumbs, fists, hands, etc., are in actual contact with the mouth at the time these oral activities occur, it seems highly possible that these activities are reflex movements called forth by the presence of the stimulus disk which apparently means food to these infants. To substantiate the plausibility of the above interpretation, the following observations are cited:

Case O, 4 weeks. The infant raises her mouth slightly to meet the approaching disk as the latter comes within a close range. Immediately afterwards some sucking movements take place.

Case U, 4 weeks 5 days. As the disk approaches its lowest point of descent, the mouth suddenly becomes wide open and the activity of the tongue is greatly increased.

Case B, 16 weeks 5 days. As the disk approaches, sucking movements are observed which disappear entirely when the disk is withdrawn to about one-third of the total distance.

With Case *L* oral activity seems to be more associated with the infant's general bodily restlessness than with her interest in the *Aufgabe.* On this point Case *L* differs sharply from the rest of the subjects.

These observations represent some of the group trends and individual differences in oral activity during sustained visual fixation. Incomplete as these records are, they nevertheless seem to support the view that the mouth participates actively, though not constructively as in the case of the form discrimination experiment, in sustained visual fixation in very young human infants.

(2). *Movements of the head.* The head, even more than the mouth, participates actively and adaptively in sustained visual fixation. Of the various types of head movements observed in the present study,

the most predominant are rotations on the vertical axis. The other types, arranged in the order of decreasing frequency are: (*a*) abductions to right and abductions to left (or clockwise and counterclockwise rotations); (*b*) extensions and flexions of the neck; (*c*) shifting of the head as a whole from one place to another in the crib; and (*d*) lifting of the head from the crib and holding it in that position for varying lengths of time. Any of these types of head movements may appear singly or in combination with any other type or types. Whether pure or mixed, all these movements can be classified into one or the other of the following two categories: Spontaneous Movements and Adaptive Movements.

(*a*). *Spontaneous movements.* Spontaneous head movements are abundantly exhibited by all of the 25 subjects during their waking hours even in the presence of the stimulus disk. Analysis of the available data shows that there are at least four different causes underlying these movements. They are: (1) *physiological* factors, such as sneezing, coughing, yawning, hiccoughing, crying, and whimpering; (2) *postural factors,* such as a strong drive on the part of the infant to rotate toward a mid-position, even though physiologically he is not sufficiently mature to assume such a position, or a tendency, due to the same physiological immaturity, to abandon a mid-position after having assumed it for a brief duration; (3) *spontaneous "curiosity"* about the immediate environment which causes the infant to extend his neck as far as possible, to lift his head from the crib, or to rotate his head to right or to left in his persistent attempts to look about him; (4) *motor exuberance* or a powerful physiological drive to exercise the muscles which produce head movements, and to move around simply for movements' sake.

Individuals differ markedly in the motility of the head. This difference tends to remain consistent throughout the age levels covered by the present study. The major group trend is toward immobilization with development. The process through which the once highly mobile head is brought under control is a gradual and orderly one, and resembles essentially the process of immobilization with growth in the case of the trunk and limbs. In order to avoid unnecessary repetition, therefore, we shall postpone any further discussion of this process to the following section in which the stages of development through which spontaneous bodily movements, in-

cluding head movements, become more and more controlled, will be discussed in greater detail.

(*b*). *Adaptive movements.* At least five different forms of adaptive head movements have been observed in the present study.

1. A very slight uplifting of the chin in visual fixation is necessitated by the present experimental set-up. This form of activity is, therefore, observed in all the subjects as soon as they are able to fixate. Later, this reaction is elaborated by a further slight extension of the neck as the stimulus disk nears its farthest point of retreat, and a slight flexion of the neck as the disk comes close to the nearest point of approach. A modification of this response, initiated by Cases *O* and *Y* at the ages of 4 weeks and 2 weeks 2 days respectively, is to elevate the chin slightly to meet the approaching disk.

2. At the stage of alternation of ocular dominance, the rapid and rhythmic alternation of fixation between the two eyes is accomplished by rhythmic rotation of the head: left and counterclockwise (abduction to left), right and clockwise (abduction to right), etc.; or left and clockwise, right and counterclockwise, etc. This type of adaptive head movements is observed in 15 of the total 25 subjects (the others are either too young or too old for it), and first appears at the median age of 7 weeks 6 days.

3. As the stimulus disk reaches its nearest point of approach, the head is observed to push backward, if the infant assumes a *t-n-r* attitude, or downward, if he lies in a mid-position. This is apparently an attempt to gain a more distinct view of the disk by increasing the distance between it and the eyes. The age range at which this form of behavior first appears is 2 weeks 2 days to 15 weeks. A modified and more effective form of response, employed by Case *K* at 9 weeks of age, is to rotate the head from a mid-position to 20°-25° left of it.

4. For exploratory and adaptive responses in sustained visual fixation, instead of employing eye movements, which is generally the case with most of the subjects, two infants—Cases *K* and *L*, at the ages of 9 and 3 weeks respectively—employ head movements. These movements are primarily rotations on the vertical axis and extensions and flexions of the neck. They are well timed and well controlled. Both subjects achieve perfect fixations with them.

5. Case *A*, beginning at 18 weeks 3 days of age, turns her head away as soon as the stimulus disk starts to descend. Case *I*, at 13 weeks 2 days of age, turns her head regularly and frequently from the disk during the fixation. These instances are but two of the many examples of negative adaptation to the experiment.

The above are only a few of the many adaptive head movements shown by the infants in the present study. In conclusion, it may be said that, contrary to popular belief, adaptive head movements in sustained visual fixation appear very early in human infants.

(3). *Movements of the trunk and limbs.* Movements of the trunk and limbs during sustained visual fixation can be conveniently grouped under three sub-topics as follows:

(*a*). *Spontaneous movements.* Anybody who watches a human neonate for the first time is invariably impressed by the amount and variety of the infant's spontaneous activities during his waking hours. These activities are brought under some degree of control for brief moments as soon as the infant is able to fixate an object. In the present study visual fixation makes its first appearance only a few hours after birth. The temporary suppression of these spontaneous bodily activities during fixation is so obvious that it has been used as one of our criteria for visual fixation.

During its earliest stage of development this suppression of spontaneous activities is only partial and momentary. As the infant grows, the suppression increases both in degree and in duration until the infant lies in perfect immobility as he watches the stimulus disk approaching and retreating before him. At first this immobility has a somewhat passive appearance, but with further development it assumes a significantly active aspect. The child is no longer merely quietly attentive, but is rigidly attentive; every muscle of the body appears to be strained in an effort to obtain the most distinct view possible of the stimulus object. With further growth this muscular and nervous tension gradually gives way to a more poised and relaxed fixation attitude. The infant is just as attentive to the disk as he has been previously, but he now seems to be more adept in conserving his energy and in confining the act of fixation more and more to the head region. Thus, with growth, visual fixation becomes more specific and less irradiative.

(*b*). *Adaptive movements.* If the suppression of spontaneous

movements were the only contribution made by the trunk and the limbs in sustained visual fixation, the statement above that visual fixation in human infants involves all parts of the body would not be quite true. However, in addition to the inhibition of spontaneous movements, the body and its extremities produce adaptive movements during ocular fixation. As early as 2-3 weeks of age with some infants, but somewhat later with most, a number of subjects are observed to raise the arms, arch the back, adduct the legs, and point the feet upward toward the descending disk during the experiment. Furthermore, at a somewhat earlier age, when alternation of ocular dominance prevails, many infants contort the body and extend and flex the arms rhythmically in keeping with the rotary movements of the head in fixation. At about the same time a number of infants are repeatedly seen tensing the trunk, stiffening the neck, and pressing the body, including the head, down hard against the mattress, as the stimulus object comes within a very close range, as if they were attempting to increase the distance between the disk and their eyes. With slightly older infants (10-20 weeks) the last foot of descent of the disk is frequently greeted by outstretched hands which, nevertheless, do not make any attempt to close in on the disk. From these and other similar instances it is obvious that the trunk and the limbs participate *adaptively* in sustained visual fixation.

(*c*). *Expressive movements.* The third type of movements of the trunk and limbs during ocular fixation conveys affective concomitant of the subjects. As early as the second and third weeks of age, intensified bodily activities are observed when the stimulus disk comes within the reaching distance. They appear to be expressions of pleasant excitement. By the end of the second month these movements become more specific: the infants wave their arms and kick their feet as the disk nears its lowest point of descent. At a still later age bouncing of the body as the disk comes within a close range is added and incorporated into the total pattern of pleasant excitement.

All the movements summarized above (spontaneous, adaptive, and expressive) are typical of the concomitant responses of the trunk and limbs in sustained visual fixation.

Finally, reference may be made to 15 infants whose cineographic records are available with respect to the relative activity of their arms

in the *t-n-r* attitudes. The face arm is more active in 10 (66.67— per cent) of these infants and less active in 4 (26.67— per cent). The responses of the one remaining case (6.67— per cent) are inconsistent.

4. *Other Related Phenomena in Sustained Visual Fixation*

a. Diverted regards. Ocular fixation and diverted regards are intimately related throughout the stages of development in sustained visual fixation covered by the present study. In Stage I (Absence of Fixation) neither ocular fixation nor diverted regards exist. In Stage V (Perfectly Sustained Fixation) ocular fixation reaches its peak, while diverted regards are completely excluded. In all the other stages the two phenomena coexist and are inversely proportional. From Stage II to Stage IV inclusive [i.e., Dawning of Fixation, Sustained Near-fixation, and Pre-perfect (Variable) Fixation] while fixation improves steadily both in quality and in duration, diverted regards diminish proportionately in frequency as well as in continuance. In Stage VI [Post-perfect (Roving) Fixation] as fixation takes a downward course, diverted regards show an upward surge.

It is perhaps of interest to list factors underlying different types of diverted regards which are: (*a*) present in most or all of the developmental stages in sustained visual fixation, (*b*) characteristic of each stage, and (*c*) peculiar to individual infants.

(1). *Factors found throughout the six developmental stages.*

1. Initial torpor and "warming up."
2. Emotional disturbances due to various known or unknown causes.
3. Drowsiness.
4. Sneezing, hiccoughing, yawning, etc.
5. General physical restlessness.
6. Physical fatigue after having fixated the stimulus disk for varying lengths of time.

(2). *Factors typical of each developmental stage.*

1. Stage II—Dawning of Fixation.
   a. Inability to adapt successfully to intense illumination.
   b. General lack of sustained vigor.

2. Stage III—Sustained Near-fixation.
   a. The infant's inability to fixate the stimulus disk with a sustained regard beyond a certain limit in distance.
   b. His repeated attempts to abandon his initial partial or complete *t-n-r* attitude and to assume a mid-position; and his natural tendency, due to his physiological immaturity, to reveit to the original attitudinal pattern.
   c. Disturbances caused by a sudden increase in the illumination.
3. Stage IV—Pre-perfect (Variable) Fixation.
   a. The infant's difficulty in maintaining a mid-position, even though he assumes the position spontaneously.
   b. His widening interest in his immediate environment which rivals his interest in the stimulus disk.
   c. The beginning of his distraction by his own fingers.
4. Stage VI—Post-perfect (Roving) Fixation.
   a. The infant's rapidly waning interest in the stimulus disk.
   b. His ever widening interest in his immediate environment which has become a constant and powerful rival of sustained visual fixation.
   c. Finger-play as a formidable source of distraction.
   d. The infant's newly developed tendency to look overhead.
   e. His new "game" of seeing dark and light in rapid succession.
   f. His motor exuberance.

(3). *Factors peculiar to individual infants.*

1. Immaturity in the development of coördinate compensatory eye movements to compensate adequately for head movements (Case *L*, 4 weeks 1 day).

2. Reversion of the head from a mid-position to a partial right *t-n-r* posture as a result of the infant's loss of interest in the stimulus disk (Case *A*, 19 weeks 6 days).
3. Lip smacking (Case *E*, 22 weeks 4 days).
4. Interest in the eye-piece of the camera (Case *G*, 8 weeks 6 days–9 weeks 6 days).
5. The infant's apprehensive survey of the environment during her initial experience in the experimental cylinder (Case I, 10 weeks 2 days).
6. The infant's change of body posture from a complete right *t-n-r* to a complete left *t-n-r* attitude (Case *X*, 1 week).

A systematic examination of the above list of factors underlying different types of diverted regards leads to the following conclusions:

1. These underlying factors of diverted regards are combinations of postural, physiological, and psychological elements which dominate and recede in accordance with the ever-changing pattern of growth.

2. The varied types of factors underlying diverted regards and the order of their appearance are not only characteristic of group trends and individual differences, but are also indicative of the main developmental tendencies. The latter, in turn, show that growth is an all-inclusive phenomenon, of which the development of sustained visual fixation is but a component part of the complex whole. An intensive study of fixation reveals to us, in miniature, the fundamental laws governing growth, just as an intelligent appreciation of these laws enables us to understand and evaluate a particular form of behavioral development.

b. The effect of the intensity of illumination on the behavior of infants in sustained visual fixation. As the reader will remember, the intensity of the illumination used in the present study is 90-75 foot candles. This strong lighting has been selected for two purposes: (*a*) to insure clear cinema records of the subject, particularly his eyes, in action; (*b*) to create a satisfactory one-way-vision screen between the infant and his visual field on one hand, and the experimenter and the external surroundings on the other.

Repeated observations show that the bright illumination has several potent effects on the behavior of the infants as follows:

1. With the 11 neonates the lighting condition causes an immediate protective closing of the eyes as soon and as long as the lights are on. Not a single child in the entire group is able to withstand the full force of the illumination before one week of age, and two of them are unable to see normally until they are 2 weeks 1 day old. The mean age for the group is 1 week 5 days. With the three infants who participate in the experiment after they have reached 1-4 weeks of age, the illumination has just as overwhelming, though not as lasting, an effect. Beyond four weeks of age the infants are able to open their eyes normally under the illumination even during their initial sitting. Because of the adverse effect of the lighting condition on the neonates, the first experiments have to be performed under reduced illumination; therefore, with one exception, we are unable to record cinematographically the oculomotor responses of our subjects in visual fixation during the first week or two of their lives.

2. Owing to the fact that the illumination is more intense at the zenith of the visual field than at the horizon, the younger infants tend to avoid lying in a mid-position, or to avert the head after having occupied a mid-position initially.

3. A number of diverted regards, even among infants of five weeks of age and older, are obviously caused by the intense illumination. This factor, in turn, delays the age at which perfect fixation is first attained.

4. Most of the blinking during the experiment is unquestionably caused by the illumination.

5. As is to be expected, the heavily pigmented eye is able to withstand the strong illumination much earlier and more effectively than the thinly pigmented eye.

c. Blinking. In the preceding section mention has been made of blinking as one of the products of the intense illumination. This statement is based on the following facts:

1. The number of blinks increases noticeably and proportionately with augmentation in the intensity of the illumination.

2. It also increases as the infant rotates his head from a completely averted position where the illumination is 75 foot candles to

a partially averted or mid-position where the lighting is more intense, in the same experimental sitting. The converse is true as the infant reverts from a mid-position to a partial or complete *t-n-r* attitude.

3. Blinks decrease gradually in number as the infant becomes more and more fortified against the illumination by increased pigmentation in the irises.

4. Brown-eyed infants blink decidedly less frequently than blue-eyed infants.

Other observations regarding blinking are as follows:

From the standpoint of completeness of blinking, there are partial and full blinks. As a rule, more mature infants give full blinks which are clear-cut and widely scattered, while more immature infants give partial blinks which are often bunched and difficult to separate from one another.

From the standpoint of interspacing of blinking, there are single, paired, and grouped blinks. The first two kinds, which are generally unmistakable and well scattered throughout the experiment, are usually found in older infants who have become well adapted to the experimental situation. The last kind, grouped blinks, are found most frequently in very young infants. They are used also by all other infants (*a*) when a sudden increase in the illumination causes some temporary disturbance, and (*b*) when the ocular muscles are fatigued after having been engaged in sustained visual fixation for some time. Furthermore, grouped blinks are employed by some infants (*a*) when the stimulus disk comes within a close range (3-8 inches from the eyes), and (*b*) when these infants attempt to free their eyes from a strabismic condition.

Within a general developmental pattern of blinking there are individual patterns which are adhered to very consistently by individual infants. In other words, the pattern of blinking is as individualistic as that of facial expression or of vocalization.

Cinema records have "captured" and preserved for us a few interesting variations in blinking which normally is a binocular phenomenon, but which in these exceptional instances approaches monocularity. Both Cases *H* and *I* at 11 weeks to 11 weeks 2 days are observed to close one eye only in blinking; the other eye closes only slightly or barely moves.

d. Palpebral fissures. Like blinking, which has just been dis-

cussed, variations in the shape and size of palpebral fissures are part of the infant's total response pattern in sustained visual fixation. The following findings, derived from the analysis of available cinema records, serve as a basis for the above statements.

1. Within the age levels studied, the width of the palpebral fissures increases appreciably with age. This increase is the result of the combined effect of two apparently unrelated factors; namely, the infant's negative adaptation to the strong illumination in the experimental cylinder and the phenomenon of growth.

2. During ocular fixation all the subjects raise the upper eyelids, thereby widening the palpebral fissures, when the stimulus disk is beyond a distance of about one foot. They allow the upper eyelids to return to a normal position, thereby narrowing the palpebral fissures, as the disk comes within a close range (within one foot). While the magnitudes of the raising and lowering of the upper eyelids vary somewhat with individual subjects, they are slight in all cases.

3. As the stimulus disk comes close to its nearest point of approach, in addition to the lowering of the upper eyelids to a normal position, the subjects simultaneously let down the lower eyelids slightly. The latter movement has an opposite effect on the width of the palpebral fissures to that produced by the lowering of the upper eyelids. In accordance with the balance of these two effects, the palpebral fissures either widen, or narrow, or remain virtually the same. Results of the present experiment show that as the disk comes within a distance of about one foot, the width of the palpebral fissures increases in 9 (36 per cent), decreases in 5 (20 per cent), and shows no appreciable change in 11 (44 per cent) of the total 25 subjects.

4. The fixating or the dominant eye in the early steps of development in oculomotor responses of sustained fixation is very frequently more wide open than the non-fixating or the subordinate eye.

5. Normally the fixating eye is round, its upper eyelid is pushed back and tense, and its superior palpebral sulcus is deepened by creasing. In contrast, the resting eye is oval-shaped, its upper eyelid is slightly drooped and relaxed, and the crease of its superior palpebral sulcus is partially or completely smoothed out.

6. A significant individual difference has been observed: Case

C's palpebral fissures vary in width not only from day to day in accordance with the subject's state of adaptation to the illumination and with the factor of growth, such as are found in all other infants; but also within the same day according to the distance of the stimulus disk from the eyes. The palpebral fissures widen noticeably as the disk recedes, and narrow in the same manner as the latter approaches. In this last respect, Case *C* differs sharply from all the other subjects.

e. Duration of experiments. As the reader will remember, the experiment is started directly after the stimulus disk has been maneuvered into position by the rotation of the experimental cylinder. The movement of the disk is initiated as soon as the subject directs his regard to the stimulus object, and is continued at about two inches per second as long as the infant continues to fixate, until the disk has travelled all the way to the 36-inch mark and back to the starting point. At the first sign that the regard is being diverted, the movement of the stimulus object is immediately suspended. It is continued only when the subject renews his fixation. In consequence, the duration of a given experiment is determined by the quality and continuance of the infant's visual fixation during this particular experimental sitting.

The sharp descent of the duration of experiment curve shown in Figure 6 during the first 11 weeks is due to the combined effect of the infants' fast and successful adjustment to the general experimental condition and the rapid improvement in their ability to sustain an ocular fixation. The relatively less steep ascent of the same curve from the eleventh to the fifteenth week is caused by the rapidly waning interest in the stimulus disk on the part of the subjects who are becoming increasingly too old for the extremely simple experimental set-up. The irregularity of the curve after the fifteenth week is the joint result of three factors: (*a*) A sharp decrease in the number of observations made at each age level; (*b*) the outgoing of a number of old subjects and the incoming of new and older infants at these age levels; and (*c*) the capriciousness of these new and older infants who master the *Aufgabe* in one or two sittings, and who lose interest in it almost immediately afterwards.

In conclusion, it may be pointed out that the general trend of a sharp and steady rise, succeeded by a more gradual and irregular fall,

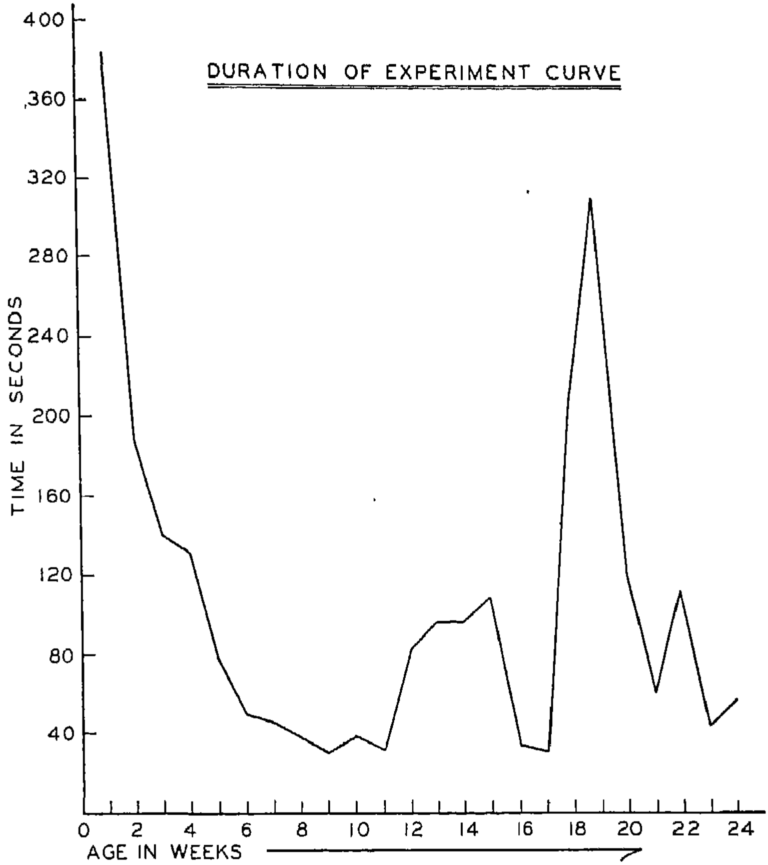


FIGURE 6

as revealed in the data on the duration of experiments, harmonizes amazingly well with the same general trend of rapid improvement and slower decline, as shown by the results on the stages of development in sustained visual fixation. For this reason, the duration of experiment data would seem to lend further support to our findings on the development of ocular fixation in human infants.

F. Discussion

Among the findings presented in the preceding section the two most significant ones are: (*a*) that sustained visual fixation of a

two-inch black disk, which recedes and approaches in front of the subject's eyes within a distance of 36 inches against a uniformly white background, appears in a rudimentary form in the human infant shortly after birth, and reaches its peak at about 4-5 weeks; (*b*) that the infant, even after he has arrived at the stage of Perfectly Sustained Fixation, continues to respond *differently* to the stimulus disk when it is within a close range (within one foot) than when it is farther away.

In regard to the first finding it is significant that the point of greatest dissension among various writers concerning visual fixation is the time of its first appearance in the infant. Blanton (4), Watson (29), Sherman and Sherman (24), and others assert that visual fixation is present at birth. Darwin (9), Jones (18), Bryan (5), Beasley (2), and others maintain that it appears shortly after birth. Preyer (23), Shinn (25, 26, 27), Guernsey (17), Bühler (6) and others hold that it does not appear until 2-4 months. A careful study of the above literature reveals two fundamental causes of this disagreement. First, while not a single one of these writers has attempted to define visual fixation, it is obvious that they have in view at least two divergent concepts of the phenomenon. The first group and most of the second would define visual fixation as simply the directing of the eyes toward a stimulus object or the following by the eyes of that object as it moves slowly across the visual field. The last group would define it as the "directing of the eye so that the object which is 'looked at' occupies the visual axis, its image falling upon the fovea" (3, p. 211). These authors would include, as criteria of visual fixation, such oculomotor phenomena as the convergence and divergence of the eyeballs, the bulging and flattening of the lens, and the contraction and dilation of the pupils. Second, with very few exceptions the findings of these investigators are based on observations made under "natural" or very inadequately controlled conditions in which a flashlight, a candle flame, or some such object was used as the stimulus.

Apropos of these two very different concepts of the nature of visual fixation, the present writer wishes to point out that the first is indeed too crude to be definitive; and the second, while very complete and exact, is inapplicable in the case of the human infant. In order to check the experiments by Watson, Beasley, and others who

uphold the first concept, the writer has repeatedly moved her fluttering fingers and then the experimental disk slowly across the visual field of every one of the four infants who begin their participation in the present investigation between 7 minutes and 1 hour and 15 minutes of age. All the subjects pursue the stimulus objects visually for 40°-60° as long as the latter are within a distance of 3-10 inches from their eyes, although they fail to fixate the stimulus disk in the experiment proper. However, close observation shows these ocular pursuits to be passive, incoördinate, and with long reaction time. Besides, they appear to be primarily peripheral rather than central ocular responses. Moreover, no immobilization of any part of the body or adaptive head and trunk movements are observed to accompany these visual pursuits. All in all, these oculomotor responses are more indicative of the infants' "diffuse general sensibility" of light and darkness than of their first step in the localization and isolation of a single object out of an undefined and undifferentiated whole.

With respect to the second concept of the nature of visual fixation as held by Preyer, Shinn and others, the present writer considers it inapplicable in the case of the human infant, because no matter what we may be able to do in the way of devising apparatus and controlling experimental conditions, we shall be unable to ascertain whether or not the image of the stimulus objects falls on the fovea. And even if it does, we still do not know whether or not the fovea is functional at birth, so that the falling of an image on it will insure a distinct vision of the stimulus object. Furthermore, the present writer does not share the belief of these psychologists that such phenomena as convergence and binocular coördination are essential in visual fixation because, as is shown by the results of the present study, fixation can be monocular as well as binocular; although it is highly probable that convergence and binocular coordination are vital to the perception of depth. To ascertain the dawning of visual fixation in the human infant it seems that the first seven criteria, listed on page 239, would be more practicable.

Concerning the question of monocular versus binocular vision at the first appearance of ocular fixation, the present investigation shows, owing to the availability of *both cinema and protocol data,* that among the 11 infants who begin their participation in the experiment im-

mediately or very shortly after birth, four use monocular fixation and seven employ monocular dominance as the first step in their ocular fixation. Not a single one of these cases is able to use binocular fixation until sometime later (Table 2).

The above question leads directly to the problem of binocular fixation which is generally conceived to be the final step in the development of eye postures and movements in the visual fixation of the human infant, and which is usually, though not invariably, characterized by the phenomenon of convergence. A careful survey of the literature in the field shows that there is as much disagreement among various writers concerning the time of the first occurrence of binocular fixation as there is in the case of the earliest indication of ocular fixation.

Thus, Beasley reports: "Binocular fixation can be elicited through a significant distance range during this period" [the first five to eight days of life]; (1, p. 626). Lucas writes: "An infant will follow a light by the end of the first week, but coördinate action in vision is not completely established until about 3 months and even then can easily be affected" (20, p. 50). Feldman reports: "*The age at which binocular fixation first occurs* has been variously given by different authorities. According to Donders, this takes place immediately after birth; according to Cuignet, it does not take place before the eighth day; whilst, according to Kussmaul, the age of its first occurrence is as late as the third to the sixth week" (12, p. 604). In another connection Feldman writes: "At the age of about three or four weeks binocular fixation with fusion occurs, but is still unstable, and hence the slightest irritation, such as trifling digestive disturbance, etc., is enough to upset the balance and to cause the baby to squint" (12, p. 600).

According to the present study, the median age for the first appearance of binocular fixation is 7 weeks 2 days (see Table 2).

The underlying causes of this wide divergence in the findings are the same as in the case of the time of the first appearance of visual fixation; namely, differences in terminology and variations in technique. We shall, therefore, not go into detail here. However, we wish to point out in this connection that, since one cannot effectively observe simultaneously both eyes of the subject in their relation to

the object of fixation, cineographs seem to be an indispensable instrument in the study of binocular fixation in infants.

Closely associated with binocular fixation is the phenomenon of convergence. Here authorities seem to agree that convergence is not mature at birth. However, a thorough search of the literature in the field reveals little information concerning the appearance, the development, or even the nature of this very important phenomenon in the human infant. Feldman appears to be the only author who definitely states that convergence does not occur before the fifth month (12). The present investigation places its first appearance at about seven weeks.

Dodge, in connection with his study of types of eye movements in the human adult, points out that the most conspicuous differentia of the movements of convergence are the "relative slowness of the movements, and the fact that, notwithstanding their reactive character, they permit a more or less clear perception of the field of vision during eye movement" (11, p. 327).

Another point of interest with respect to visual fixation concerns its stages of development. A number of investigators in the field have given the impression that fixation is an all-or-none phenomenon; it is either present or not present (4, 13, 18). Others have distinguished between fixation of a stationary object and fixation of an object in motion, but have failed to describe substages in the former type of fixation (23, 27). Preyer (22), Shinn (25, 26, 27), Hall (27), and Shirley (28) are among the few authors who regard fleeting pursuit movements as a preliminary stage to the prolonged fixation of an object, a sequence of development in ocular fixation which is amply supported by the results of the present investigation. The writer also agrees with Preyer, Shinn, and Hall that passive stare precedes active fixation, although she disagrees with these authors in the time of the first occurrence of each of these two developmental stages.

Minute oculomotor movements during visual fixation are another important phenomenon to be included in the present discussion. So far as the present writer is able to ascertain, no child psychologist has even mentioned the presence of this type of eye movements during ocular fixation. Dodge (10) is the only noted authority on ocular behavior who has treated in detail this type of eye movements

in the human adult. The same author also suggests two different "visual motives" for these movements: (*a*) to avoid retinal fatigue by the involuntary shifting of the functional center of the retina, and (*b*) to correct any inadequacy in binocular coördination. Later, Berens (3) added to the list a third motive; namely, to enable the fovea to traverse the different parts of the object fixated and thus to cause a complete image to be built up.

Another important factor which is intimately related to visual fixation is concomitant postural responses. In spite of the very vital rôle these responses play in the visual fixation of the human infant, very few authors have paid due attention to them. Statements such as the following are exceptional.

Darwin writes: "On the 49th day his [the infant's] attention was attracted by the bright-colored tassel, as was shown by his eyes becoming fixed and the movements of his arms ceasing" (9, p. 286). Shinn reports: "In both the preceding eye movements—turning the fovea upon an image at the margin of the retina, and following an image with the fovea—I saw a good coöperation of the neck muscles with those of the eye; not a mere primitive rolling of the head toward stimulus, but a well-adapted movement to increase the range of the eye in seeking the image. In the first instance the head was thrown backward; in the second, turned far to the side" (27, p. 61). Gesell, *et al.,* state: "His [the infant's] visual field is delimited by the postural set of the *t-n-r* attitude. . . . It [*t-n-r*] served to channelize the pathways of visual attention" (15, pp. 19, 21).

In passing, the present writer wishes to emphasize the fact that the findings here reported are not only in perfect accord with the above statements, but also show that visual fixation exercises just as great, if not greater, an influence over the postural set of the fixating infant in the selection and maintenance of that postural set as the latter does over the former in the delimitation and channelization of the field of visual attention.

Turning now to conjugate deviations, one of the two types of eye movements which are not integral parts of visual fixation, but which are closely involved in it, the present study confirms Jones' finding that the eyes of all the 75 infants tested during the first 48 hours of their lives move practically always binocularly in the follow-

ing types of movements: (*a*) in a rotary motion, (*b*) up and down, and (*c*) back and forth (18). It differs from Guernsey's observation that uncoördinated right-left eye movements occur in 60 per cent of the infants under two weeks of age (17).

From all descriptions, conjugate deviations of the exploratory variety, reported above, appear to be identical with Dodge's Type I eye movements (11).

Coördinate compensatory eye movements are the second type of oculomotor responses involved in, though not integral to, sustained visual fixation. A careful search through the literature in the field uncovers one of the earliest references to this type of eye movements by Miss Shinn. Thus the author writes: "—from about the beginning of the fifth week—she [Miss Shinn's niece] would fix her eyes on her mother's face, and roll her head sideways, keeping the eyes fixed, thus holding the image on the fovea by turning the eyeball, quite as much as if it had been the image and not her head that moved" (27, p. 60).

A more systematic and objective approach to the nature, occurrence, and development of coordinate compensatory eye movements was, however, reserved for McGinnis who encountered this phenomenon more or less accidentally in his study of optic nystagmus in early infancy (21).

In his report McGinnis conceives of the possibility of the presence of coördinate compensatory eye movements in the human infant at birth or shortly afterwards, although due to the existing experimental condition, these movements do not appear abundantly during the first few days of life (21, p. 382). Data from the present study seem to lend support to this belief.

Furthermore, the present writer agrees with McGinnis that coördinate compensatory eye movements improve markedly during the first few months of life; however, she differs from him with respect to the rate of the improvement. McGinnis seems to be of the opinion that it takes approximately six months before coördinate compensatory eye movements become really proficient (21, pp. 382-383), while the present findings show that proficiency of a high order in this type of eye movements is attained by infants of 7 to 8 weeks. Nevertheless, it should be pointed out that McGinnis admits

that his data on the phenomenon in question are too limited to permit definite conclusions (21, p. 383).

It is interesting to note that coördinate compensatory eye movements, as found in young infants of 7-8 weeks of age, bear in essence the distinguishing characteristics of the same phenomenon in human adults as described by Dodge and referred to as Type III eye movements (11, pp. 322-326).

So far our discussion has been centered on various phenomena involved in or associated with visual fixation. Now we shall turn to the second major finding in the present study: that the infant, even after he has arrived at the stage of Perfectly Sustained Fixation, continues to respond *differently* to the stimulus disk when it is within a close range (within one foot) than when it is farther away. This finding leads directly to the question of space perception. From the available evidence we are not certain whether the change in the total behavior pattern of the fixating infant, as the disk nears its point of maximum approach, is due to a change in the size or in the distance of the perceived object. Neither are we certain whether or not the behavioral modification is the result of the fact that as the stimulus object comes close to the infant, it takes on a new significance,[5] whereas it is devoid of such significance when far away. Nevertheless, this much remains positive: that the infant apparently sees the same object *differently* when near than when farther away. Here, then, we have the earliest evidence of the first step in the space perception of the human infant.

The present study is thus linked to the age-long nativistic-empirical controversy concerning the origin and development of space perception. According to the nativists, the capacity to appreciate space is innate and may be used without preliminary practice. For them space offers no empirical problems; it is appreciated at once.

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[5]By a new significance is meant a new association between the stimulus disk and such biologically significant things as food, warmth, and social intercourse with another individual. From the observations reported in the preceding section it is obvious that the responses exhibited by the infant as the disk comes within a close range are, in a large measure, similar to those when a nursing bottle is being presented to a hungry infant, or when a cold babe is being tucked into a warm blanket, or when a whimpering child is being picked up and played with by his attendant. Why the infant should behave in such a manner toward the approaching disk, we shall not attempt to answer here. The important point is that such infantile responses are present only when the disk is within a close range.

Genetic data from this experiment which seem to accord with the nativistic concepts are (*a*) persistent and consistent individual differences in sustained visual fixation despite identical training; (*b*) the presence of differential responses to far and near objects of fixation at such an early age when learning cannot play a very active rôle; and (*c*) the close resemblance between old and new subjects of the same age levels in the fixation response.

The empiricists assert that the notion of space is developed through experience, and that therefore it is essential to discover the components of the idea of space and also to determine its origin. They are of the opinion that the nativistic theory is unnecessary and gratuitous, and that the development of space perception in experience is, to a certain extent, demonstrable.

Opposed to the strictly nativistic hypothesis and supporting the empirical concept are the evidences of: (*a*) the absence of true fixation at birth, (*b*) the absence of binocular fixation until about the end of the second month, and (*c*) the absence of convergence until about the same time. While the emergence and gradual perfection of these processes undoubtedly can be attributed largely to general maturation, it is also true that learning through use starts as soon as the child is born. Consequently, in view of the results of the present investigation as a whole, it seems probable that visual space perception, as we find it even in human infants below 24 weeks of age, is the combined result of both general maturational tendencies and specific individual experiences.

Another point of interest regarding infantile space perception which is covered by the present investigation concerns the development of visual perception of distance. A survey of the literature in the field reveals the general consensus to be that a young infant cannot see as far as an older child or adult, and that distance perception increases gradually with age. Thus, according to Espinas, a two-month-old infant will not see anything farther away than 50 centimeters, the assumption being that he probably cannot (22). Cuignet reports that a two-and-a-half-month infant will see as far as 7 or 8 meters (8). Preyer, Sully, Mrs. Moore, Mrs. Hall, Mrs. Mcleish, and Mrs. Wood have all noticed increases in the distance range of perception after the first three months (27). The present study is in accord with these observations in the finding that the three-foot

distance used in the expeiiment is mastered only gradually by the newborn human infant, and is not completely conquered until the median age of 3 weeks 5 days.

While a number of investigators have observed the far point of the infant's distance perception, Shinn seems to be the only one who has touched upon the near point. She writes: "The last time [twenty-fifth day] she [Miss Shinn's niece] seemed to catch sight of my shoulder, on which a high light struck from the lamp, and not only moved her eyes, but threw her head far back to see it better" (25, pp. 65-66).

Shinn's observation has been confirmed by the present study in which the infantile attempt to increase the distance between the eyes and the stimulus disk when the latter comes too close, has been repeatedly noted.

Another interesting finding with respect to visual perception of distance is that the infant below the median age of 3 weeks 5 days can apparently follow the stimulus object farther out during its retreat than during its approach.

In conclusion, several fundamental laws of development, which have been repeatedly demonstrated by the behavior of the subjects in the present study, should be emphasized.

First, the oculomotor responses of the human infant are among the earliest complex behavior patterns to become organized and functional in the infant's adaptation to his environment. By the end of the first month the infant is able to fixate an object in the direct line of his vision with active, intense, and well-sustained regard (see Table 1). By the end of the second month binocular fixation with convergence begins to appear (see Table 2). Thus, long before the infant is able to assume command of his trunk and his extremities, he is already busily exploring and apprehending his environment with his eyes. All this goes to illustrate the law of cephalocaudal and proximodistal directions of development, first emphasized by Coghill (7) as a result of his work with the amblystoma.

Second, individual differences among the subjects of the present experiment not only are both marked and consistent, but also reveal very interesting "type" differences in (*a*) visual fixation, (*b*) attitudinal preferences, (*c*) eye dominance and postural preferences, and (*d*) manual activities. Detection of such highly consistent "type"

differences at these very early age levels would seem to emphasize the constitutional, as opposed to the purely environmental, factors in the genesis of behavior patterns in these four different fields.

Third, the law of reciprocal interweaving and spiral organization first advanced by Dr. Gesell to describe the mode of development in trunk and limb postures and motor behavior (14), is very beautifully demonstrated by the visual responses of the subjects in the present study. In an early stage in visual fixation, the ocular behavior pattern of the infant can be best described as monocularly dominant. Then there comes a stage in which binocular fixation becomes supreme. This stage is, in turn, followed by a third stage in which fixation appears to be once more monocular. However, upon closer examination it is revealed that fixation in this stage is not a case of monocular dominance in its original, primitive form; rather it is a modified form of binocular fixation, modified in order to adapt successfully to the peculiar situation to which the fixating eyes are subjected.

These, then, are the principal laws of development which are most palpably manifested in the behavior of our subjects in sustained visual fixation. Together, they give rise to a picture of intricate but orderly sequential behavior patterning in the development of oculomotor responses in particular and in the growth of the entire organism in general.

G. Summary and Conclusions

This experiment investigates the nature, occurrence, and development of sustained visual fixation in early infancy. Twenty-five infants, ranging in age from 7 minutes to 24 weeks of age, participate in the investigation. The subject is placed in an experimental crib in the center of an experimental cylinder, the inner surface of which serves as a uniformly white background for a two-inch black stimulus disk. The latter recedes and approaches slowly in front of the subject's eyes within a distance of 36 inches. Both cinema and protocol records are taken of the spontaneous behavior of the infant in response to the disk, with the emphasis on his oculomotor reactions. As a result of an intensive study of these records the following general conclusions have been reached:

1. Under the condition of the present experiment sustained visual

fixation is absent at the birth of the normal human infant; but it appears in a rudimentary form a few hours after birth, and reaches its peak at about 4-5 weeks.

2. The infant, even after he has arrived at the peak of sustained visual fixation, continues to respond *differently* to the stimulus disk when it is within a close range than when it is farther away.

3. From the time just prior to its first appearance to the time of its maximum development and its decline, sustained visual fixation in the infant goes through six stages of development as follows.

Stage I —Absence of Fixation.
Stage II —Dawning of Fixation.
Stage III—Sustained Near-fixation.
Stage IV —Pre-perfect (Variable) Fixation.
Stage V —Perfectly Sustained Fixation.
Stage VI —Post-perfect (Roving) Fixation.

4. The four developmental steps in eye postures and movements of fixation are: (*a*) Monocular Fixation, (*b*) Monocular Dominance, (*c*) Alternation of Dominance, and (*d*) Binocular Fixation.

5. Binocular fixation, which is generally, though not invariably, characterized by convergence, first appears at about 7-8 weeks.

6. When convergence first occurs, it is carried out by a series of globus jerks. Time and practice together gradually eliminate these jerks and give convergence a smooth and continuous appearance.

7. Conjugate deviations become functional immediately after birth. In sustained visual fixation they are employed in two very important functions; namely, ocular fixation of three different types —steady monocular dominance, alternation of dominance, and modified binocular fixation—and exploratory responses.

8. Coördinate compensatory eye movements are present immediately after birth; however, they do not become truly efficacious until the fourth and fifth weeks of age. In sustained visual fixation these eye movements aid immeasurably in the infant's maintenance of the full view of the stimulus object while the head goes through various spontaneous movements.

9. Postural responses participate actively in sustained visual fixation of the infant by inhibiting spontaneous movements and by adapting the entire body to the task of fixation. These inhibitory and

adaptive bodily responses are present in a rudimentary form shortly after birth and undergo a rapid improvement during the first 24 weeks of life.

10. Visual fixation and diverted regards are coexistent and inversely proportional in four of the six developmental stages listed under the third conclusion. These diverted regards are not only characteristic of group trends and individual differences in the development of sustained visual fixation, but are also indicative of the main developmental tendencies in the human infant.

11. The strong illumination used in the present study has a somewhat retarding effect on the fixation and postural responses of the infant below four weeks of age. However, the young infant is able to adapt to it with amazing rapidity.

12. Both the frequency of blinking and the size of palpebral fissures are profoundly affected in this experiment by two divergent factors; namely, the intensity of the illumination and the phenomenon of growth. The general tendency is for the blinks to decrease in number and for the palpebral fissures to increase in size as the infant becomes older and more adapted to the experimental condition.

13. The "duration of experiment curve" reflects unerringly: (*a*) the infant's success in his initial adjustment to the requirements of the experiment, (*b*) his increasing ability to sustain an ocular fixation, and (*c*) the decline of his interest in the *Aufgabe* after his sustained visual fixation has reached its peak.

14. Individual differences among the infants not only are both marked and consistent, but also reveal very interesting "type" differences in (*a*) visual fixation, (*b*) attitudinal preferences, (*c*) eye dominance and postural preferences, and (*d*) manual activities.

References

1. Beasley, W. C. An investigation of related problems in the vision of newborn infants. *Psychol. Bull.*, 1933, **30**, 626.
2. ———. Visual pursuit in 109 white and 142 negro newborn infants. *Child Devel.*, 1933, **4**, 106-120.
3. Berens, C. The Eye and its Diseases. Philadelphia: Saunders, 1936. Pp. v+1254.
4. Blanton, M. G. The behavior of the infant during the first 30 days of life. *Psychol. Rev.*, 1917, **27**, 456-483.

5. BRYAN, E. S. Variations in the responses of infants during first ten days of post-natal life. *Child Devel.*, 1930, **1**, 56-77.

6. BÜHLER, C. The First Year of Life. (Trans. by G. Greenberg and R. Ripin.) New York: Day, 1930. Pp. x+281.

7. COGHILL, G. E. The early development of behavior in the amblystoma and in man. *Arch. Neur. & Psychiat.*, 1929, **21**, 989-1009.

8. CUIGNET, L. De la vision chez le tout jeune enfant. *Ann. ocul.*, 1871, **66**, 117-126.

9. DARWIN, C. A biographical sketch of an infant. *Mind*, 1877, **2**, 285-294.

10. DODGE, R. An experimental study of visual fixation. *Psychol. Rev., Monog. Suppl.*, 1907, **8**, No. 35, 1-95.

11. ———. Five types of eye movement in the horizontal meridian plane of the field of regard. *Amer. J. Physiol.*, 1903, **8**, 307-329.

12. FELDMAN, W. M. The Principles of Ante-Natal and Post-Natal Child Physiology, Pure and Applied. London: Longmans, Green, 1920. Pp. vii+694.

13. FIGURIN, N. M., & DENISOVA, M. P. [A short diagnostic outline of the development of the child up to one year of age.] *Novoe v refleksologii i fiziologii nervnoi sistemy*, 1926, **2**, 282-308.

14. GESELL, A. Reciprocal interweaving in neuro-motor development. A principle of spiral organization shown in the patterning of infant behavior. *J. Comp. Neur.*, 1939, **70**, 161-180.

15. GESELL, A., HALVERSON, H. M., THOMPSON, H., ILG, F. L., CASTNER, B. M., AMES, L. B., & AMATRUDA, C. S. The First Five Years of Life: A Guide to the Study of the Preschool Child. New York: Harper, 1940. Pp. v+393.

16. GOTTSCHALDT, K. Der Aufbau des kindlichen Handelns. Vergleichende-Untersuchungen an gesunden und psychisch abnormen Kindern. Leipzig: Barth, 1933. Pp. vii+227.

17. GUERNSEY, M. A quantitative study of the eye reflexes in infants. *Psychol. Bull.*, 1929, **26**, 160-161.

18. JONES, L. T. A study of behavior in the newborn. *Amer. J. Med. Sci.*, new series, 1927, **174**, 357-362.

19. LING, B. C. Form discrimination as a learning cue in infants. *Comp. Psychol. Monog.*, 1941, **17**, No. 2, 1-66.

20. LUCAS, W. P. The Modern Practice of Pediatrics. New York: Macmillan, 1927. Pp. x+962.

21. McGINNIS, J. M. Eye-movements and optic nystagmus in early infancy. *Genet. Psychol. Monog.*, 1930, **8**, No. 4, 321-430.

22. PRATT, K. C., NELSON, A. K., & SUN, K. H. The Behavior of the Newborn Infant. Columbus: Ohio State Univ. Press, 1930. Pp. v+237.

23. PREYER, W. The Mind of the Child: Part I. The Senses and the Will. (Trans. by H. W. Brown.) New York: Appleton, 1888. Pp. v+346.

24. SHERMAN, M., & SHERMAN, I. C. The Process of Human Behavior. New York: Norton, 1929. Pp. 5-227.

25. SHINN, M. W. The Biography of a Baby. Boston: Houghton Mifflin, 1900. Pp. iv+247.

26. ———. Notes on the development of a child. *Univ Calif. Publ. Educ.*, 1893-1899, **1**, iii+423.

27. ———. Notes on the development of a child: II. The development of the senses in the first three years of childhood. *Univ. Calif. Publ. Educ.*, 1907, **4**, v+258.

88. SHIRLEY, M. M. The First Two Years: A Study of Twenty-five Babies. *Vol. II, Intellectual Development.* Minneapolis: Univ. Minnesota Press, 1933. Pp. vii+513.

29. WATSON, J. B. Psychology from the Standpoint of a Behaviorist. Philadelphia: Lippincott, 1929. Pp. xvii+458.

30. YALE CLINIC OF CHILD DEVELOPMENT. Research Film: *The Growth of Visual Fixation in Early Infancy.* An Experimental Genetic Study. (B. C. Ling). 400 feet, 16 mm. silent.

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A STUDY OF FRUSTRATION IN CHILDREN*[1]

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A. THE PROCEDURE

In order to make the statement of purpose of this investigation more meaningful, it seems necessary first briefly to describe the procedure. Children were asked to meet the experimenter to draw pictures for him; the time and place were at their own convenience. The experiments were conducted at home, in the psychological laboratory, and at the summer colony where the authors were members of the recreational staff.

On the table between the experimenter and the child were a large stack of white paper and a supply of six or more sharpened pencils. The only other person in the room was an associate (either the senior author or an undergraduate student). The child was told that this other person in the room was there because he wanted to observe how children draw. He sat off to one side and behind the child.

Using the Goodenough procedure in the *Drawing of a Man Test* (4), the experimenter asked the child to *"Draw the picture of a man. Make the very best picture that you can."* (If at any time the child asked any questions, the experimenter's reply always consisted of a repetition of the instructions which had just been given with no further explanation.) When the drawing was completed, the experimenter took it and, handing a clean sheet to the child, said, *"Draw another man; this time a better one."* At the end of the second and succeeding drawings this procedure was repeated, except when the child balked. In such cases the following procedure was used: The experimenter said *"Won't you draw this one?"* If the

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[1]Dr. Olive Cooper cooperated in providing children for examination in the Springfield Child Guidance Clinic Dr. Seth Arsenian shared in setting up the experimental procedure. Mr. Bavelas conducted the experiment proper as part of an undergraduate research project under the guidance of the senior author.

child drew, the experiment went on as though no refusal had been made; that is, the child was again presented with a clean sheet of paper and instructed, "*Draw another man; this time a better one.*" If the child did not respond to the first appeal ("Won't you draw this one?") the experimenter said, "*Won't you draw this last one?*" If the child drew, the experiment again continued as though no refusal had been made. If the child did not respond to the second appeal the experiment was considered at an end. It was planned that the experiment could terminate in any one of three ways: the child might refuse to draw; the child might "break down" in some way which would necessitate stopping the experiment; or the child might draw as many as 15 drawings, which number was set arbitrarily as a limit. In some cases parents or others called for the child before 15 drawings were done.

The records kept were: (*a*) the drawings, (*b*) a complete account of verbal activity, (*c*) a log of time spent on each drawing from the moment of instructions until the child returned the paper, (*d*) a description of physical activity, (*e*) the mental age for each drawing as calculated by the Goodenough scoring procedure (except in cases in which the nature of the drawing made scoring impossible or meaningless), (*f*) name, age, sex, (*g*) any unusual facts known about the case. For the present report no special study of the clinical social histories was made.

B. The Purpose

The purpose of this investigation was to explore a method of studying frustration in children, and to analyze the responses of a small group of children in this particular situation. The experiment is characterized (*a*) by the use of social approval, mainly of the experimenter, as the desired goal; (*b*) by the withholding of approval, implied but unexplained disapproval, and possibly satiation as sources of frustration; (*c*) and the situation becoming progressively and cumulatively more frustrating.

C. Analysis of the Experimental Situation

Cultural anthropologists and students of social psychology have stressed or implied in their reports that the core of the frustration experience lies in the withholding or withdrawing of social approval,

or the expression of positive disapproval. The literature on rewards and punishment is large. In many of the experimental studies of frustration with animals and children the emphasis has been on the attainment or avoidance of *objects* or *physical conditions* rather than social relationships (2, 3, 6).

In the present experiment it was planned that the major goal of the child should be the retention and increase of social approval of the adult-in-the-situation through the production of satisfactory drawings in a friendly atmosphere. There was to be sufficient interference with the attainment of this goal so as to produce frustration and its consequent reactions.

One might ask: Does the experimental situation as described involve frustration? "Frustration," say the Yale group (3, p. 11) is, "that condition which exists when a goal-response suffers interference." The question now becomes: Were the children in this investigation "instigated" or motivated toward some goal and were they interfered with in their attainment of it?

First, it is believed that the children did come to the experimental period "goal-minded" to retain the approval of the experimenter and even to enhance their relations with him. Some were also "goal-minded" to have a good time, *per se.*

1. Nine of the children were close friends of the experimenter or the senior author. Of these, one was the sister of the experimenter, two children were close family friends, two were members of the experimenter's recreational club, and four were members of a summer colony in which both authors, as recreational and educational directors, had responsibilities to them. These children had much to gain by continued and increased good will and had histories of pleasant and confidence-producing experiences with either or both of the investigators.

2. Nine of the children were cases of the local child guidance clinic. They were selected by the director as being children whose rapport with the clinic and its workers was at a high level and who were coöperative in its therapeutic program. The children were led to believe that the "test" was part of the program of finding out what they could do best, part of a study of their abilities and interests. While it is not known exactly what each clinical case's attitude toward the experimenter was, it can be assumed that at least

they respected the clinicians and those to whom the clinicians introduced them. Since they knew that the task was being imposed in order to help them, they doubtless were reasonably motivated to do as well as they could for the experimenter. They knew he would confer with the psychiatrist later.

3. There was evidence from the unrecorded conversations incident to making the appointments and in connection with the "build-up" concerning the pending experience, that the children expected a good time and were eager to come to the appointed place. The recorded conversations of most of the children also indicate the anticipated pleasure. Some expressed doubt as to their drawing ability, but no one resisted the idea that drawing was to be done. Two sisters, in spite of suggestions to the contrary, gave evidence of expecting that the situation would be quite test-like; they knew that the senior author was a man who "studies people." However, they were intimate family friends and showed much enthusiasm and confidence.

4. At the end of each drawing the importance of one of the goals —approval of the experimenter—was enhanced by the demand for a better drawing. As will be indicated shortly, this feature also is a variable causing interference.

Second, it is believed that the experimental set-up caused interference with respect to the achievement of the goals—social approval and a pleasant time. Certain factors were intended to shift the attitudes and behavior of the children:

1. The subjects were unable to obtain the expected social approval from the experimenter. The experimenter said nothing other than the words described above in the procedure. Questions demanding information about what was expected and "leading" questions designed to secure overt approval were answered only with a repetition of instructions. The experimenter attempted by his voice to be neutral; his speech was given minimum inflection consistent with meaning.

2. Closely allied with the withholding of positive approval was the implied disapproval inherent in the instructions, *"Draw another man, this time a better one."*

3. To the child the task was indeterminate as to length, but the supply of pencils and the ream of paper gave circumstantial evidence that the sitting would be long.

4. The drawing period with each child usually lasted more than one hour. There were no idle moments and no specific opportunity was given for attention to needs for elimination and thirst. Doubtless fatigue was a factor which facilitated the onset of reactions which arise from frustration.

5. The repetitive character of the task introduced the possibility that satiation would be a potent factor. That is, there could be a change from drawing as a pleasant task to drawing as an unpleasant task even apart from the social approval factor.

Lewin, after considering the preliminary draft of this paper, urged the writers to observe that satiation, defined in terms of Karsten's (7) experiment, is a major factor.

The authors feel that their experimentally induced condition was not one of satiation *alone*, such as those which were studied by Karsten and other of Lewin's students. In those experiments the subjects were told to perform a very simple, repetitive task but were free to stop as soon as they had enough of it. Here, however, the mode of terminating the task was unknown to the children and also great pressure was placed upon them to continue. Further, the task was considerably more complicated than the drawing of Karsten's simple designs. The children drew a maximum of 15 drawings in about an hour and a quarter and they had the whole range of artistic and graphic possibilities since no size, shape, or sex of man was specified. Satiation doubtless contributed to the shift from positive to negative valence. In a personal communication, O. H. Mowrer calls attention to confusion in the use of the term satiation:

> ". . . this term ordinarily refers, as I understand it, to a state of repletion in which a given need is fully gratified. In your situation the experimenter quite explicitly withholds his approval. The child keeps attempting to obtain approval (by drawing more and more men) or 'gives up'. Is not this behavior much more comparable to extinction than to satiation?"

In this paper, the term satiation is used in the simplest descriptive sense indicated by Lewin's statement (8, p. 254): "Psychical satiation is a disinclination to execute the act yet again." No attempt is made just now to probe further than that.

D. Frustration and Cognition: Changes in Mental Age

Common observation and some experimental studies show that frustration affects the productivity and intellectual abilities of the frustrated person. The frustration may increase or decrease the cognitive ability. A series of low marks on weekly tests and a failing mid-term exam may or may not "challenge" the college sophomore in psychology. Furthermore, this frustrating experience in psychology may increase or decrease the quality of his performance in other subjects, say physics. The basketball coach has to "jerk" one angered player because his skills and judgment become impaired. Another player on the floor, likewise frustrated, suffers no such impairment and actually may seem to perform more brilliantly.

Barker (1) studied the effects of frustration upon the cognitive ability of pre-school children. Children were prevented from attaining a highly desired goal by a physical barrier which did not interfere with their playing with otherwise attractive toys in the same room. The measurement of cognitive ability[2] was made from observation of the children while playing with these toys in the presence of the barrier. His basic question was "What is the effect of a frustrated need upon the intellectual level of behavior not directly related with the satisfaction of that need?" After showing that the intellectual ability does vary with the psychological situation of the individual, he observes that "frustration may result in a reduction or in an increase in the efficiency of the cognitive abilities in general." He analyzes these two divergent trends into subtypes.

The present experiment differs from Barker's in one main essential. Whereas Barker purposely studied the effect of a "background of frustration" on the intellectual level by means of other non-frustrating play materials in the same physical room in which the frustration occurred, this investigation studied the effect of frustration on cognitive level *within the narrow field in which it occurred*. By using the "Drawing of a Man Test" it was possible to get a measure of mental efficiency by a well accepted and standardized procedure. The term "mental age," of course, is strictly applicable only to the first drawing; the ratings on subsequent drawings are expressed in

[2]There is some question regarding this term. It might be safer to use more narrow terms such as "productive level" or "creative level." Since the objection does not seem serious, we shall use the expression as Barker did.

mental ages for convenience. The reliability of this test indicates that the mental age ratings should be reasonably constant in a series of retests adequately spaced in normal testing situations. If scores regularly increased, one might conclude practice was the cause. Any marked deviations or consistent trends in ratings, it is proposed, are to be interpreted as being due to the particular testing situation here employed.

Table 1 shows the data for 18 children. For two children no

TABLE 1

MENTAL AGES (GOODENOUGH SCALE) ASSIGNED TO EACH DRAWING OF EACH SUBJECT

Subjects		Trials 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	*RB*	7^{9}	7^{9}	7^{9}	6^{9}	6^{6}	6^{6}	7^{9}	6^{6}	6^{3}	6^{3}	6^{0}	6^{3}	5^{6}	7^{3}	6^{0}
2.	*BB**	(*X*)	(*X*)	(*X*)	(*X*)	(*R*)										
3.	*IB*	(*Y*)	(*Y*)	(*Y*)	(*Y*)	(*Y*)	(*T*)									
4.	*LC**	5^{6}	5^{9}	6^{6}	6^{6}	5^{6}	6^{6}	6^{0}	5^{6}	6^{0}	6^{0}	5^{6}	5^{3}	5^{3}	5^{3}	5^{3}
5.	*PD*	6^{6}	6^{9}	6^{6}	6^{3}	6^{3}	6^{6}	6^{3}	6^{3}	6^{3}	6^{0}	(*R*)				
6.	*RE**	11^{6}	13^{0}	13^{0}	(*Y*)	11^{3}	11^{0}	11^{3}	(*Y*)	(*Y*)	(*Y*)	(*Y*)	(*Y*)	(*Y*)	(*T*)	
7.	*EH*	10^{0}	9^{6}	7^{9}	7^{6}	9^{0}	7^{0}	9^{0}	6^{0}	6^{3}	5^{9}	6^{9}	6^{0}	6^{3}	7^{3}	7^{0}
8.	*BH*	(*X*)	(*X*)	(*X*)	(*X*)	(*X*)	(*X*)	(*X*)	(*T*)							
9.	*SK**	7^{0}	6^{6}	6^{3}	8^{0}	7^{3}	7^{3}	6^{9}	7^{0}	6^{6}	6^{6}	5^{6}	5^{9}	6^{9}	5^{6}	5^{6}
10.	*FL**	7^{6}	7^{0}	7^{3}	6^{9}	7^{0}	7^{0}	7^{0}	7^{3}	7^{6}	7^{9}	7^{6}	7^{3}	7^{3}	7^{3}	7^{0}
11.	*DvN*	10^{3}	10^{3}	10^{0}	10^{0}	10^{0}	10^{0}	(*T*)								
12.	*DnN*	7^{0}	7^{3}	7^{9}	6^{9}	6^{3}	(*Y*)	7^{9}	(*Y*)	6^{3}	5^{6}	6^{6}	(*R*)			
13.	*VSa**	10^{6}	10^{0}	9^{9}	10^{3}	10^{0}	9^{6}	9^{9}	10^{3}	9^{0}	10^{3}	10^{0}	10^{0}	9^{3}	9^{6}	9^{3}
14.	*VSo**	8^{9}	6^{9}	6^{9}	6^{6}	6^{3}	7^{3}	7^{3}	7^{9}	7^{6}	8^{0}	6^{9}	7^{6}	7^{6}	7^{6}	7^{6}
15.	*ES**	7^{9}	7^{0}	7^{9}	7^{9}	8^{0}	8^{3}	8^{0}	7^{9}	7^{6}	8^{0}	7^{9}	7^{3}	8^{0}	7^{9}	8^{0}
16.	*NS**	10^{9}	10^{0}	12^{3}	9^{0}	9^{6}	10^{3}	(*R*)								
17.	*DT*	10^{6}	10^{9}	10^{9}	10^{6}	10^{0}	10^{6}	10^{6}	10^{3}	10^{6}	10^{6}	(*T*)				
18.	*ET*	8^{0}	8^{6}	8^{3}	7^{3}	7^{9}	9^{0}	8^{0}	7^{0}	(*T*)						

(*)—Clinic cases.
(*R*)—Refused.
(*T*)—Trials terminated by experimenter, parents, or clinic.
(*Y*)—Drawing unscorable because of complexity.
(*X*)—Drawing unscorable because over 13 years in mental age.

ratings are possible because the drawings were above the 13-year ceiling of the test. For some the nature of certain drawings did not permit scoring, the most extreme cases being *IB* who in all of her five trials drew men in situations which rendered them unscorable, and of *DnN* who in two trials chose to write his brother's name rather than to draw a man. Others complicated their drawings. One subject, for instance, drew "baldheaded men" because, as she later revealed,

she couldn't draw hair very well. Such manifestations of intelligence would be penalized by the Goodenough scale.

Figure 1 is constructed to show the behavior of each child undei

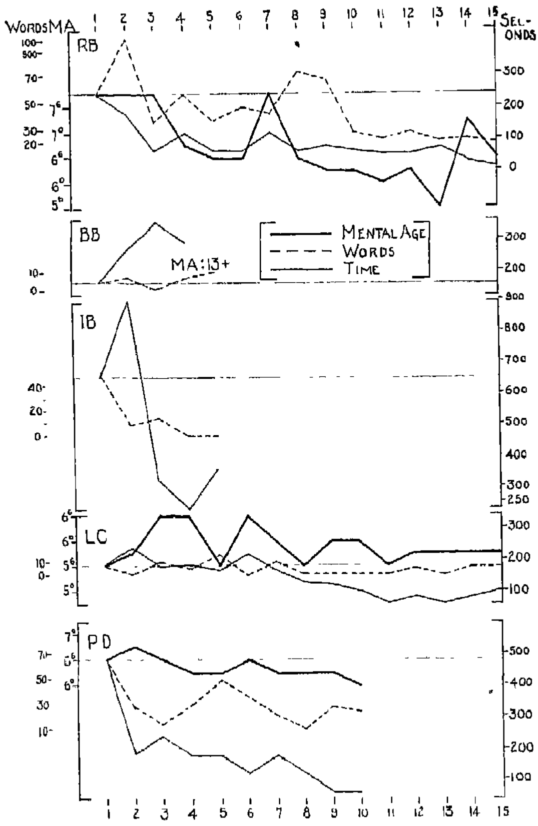

FIGURE 1a
GRAPHICAL PRESENTATION OF DATA IN TABLES 1-4 (SEE TEXT FOR DETAILS OF GRAPHING)

induced frustration with respect to (*a*) changes in *mental age* (heavy lines) as measured by Goodenough standards; (*b*) changes in *time* required to produce the drawings (fine solid lines); and (*c*) changes in *number of words* spoken by the child (broken lines) from the time he was handed a clean sheet until he returned it. Suitable scales are given at the left for each of these super-imposed graphs. The

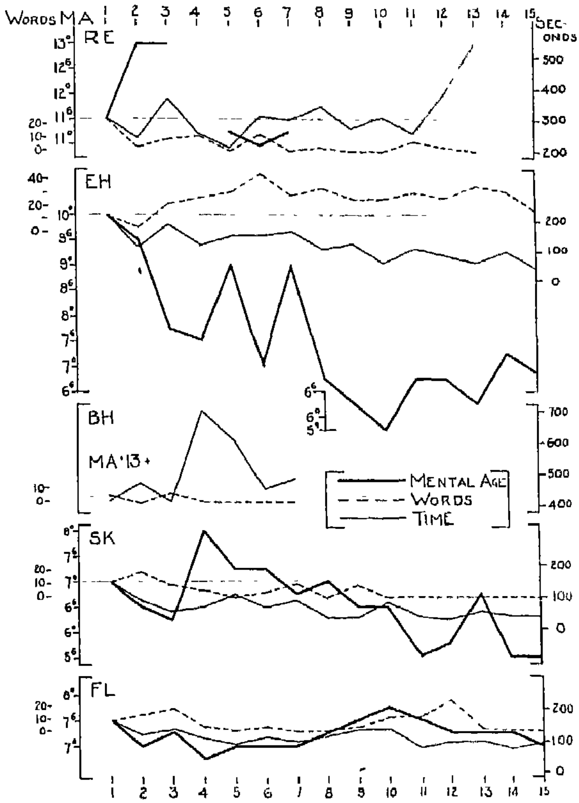

FIGURE 1b

three curves for each child begin at a common point, this being the mental age, time, and number of words spoken on the first trial. This starting point is the reference line for the whole graph of each child. There is no assumption that the units of mental age, of seconds, and of words are or can be equated. The units are chosen for convenience but are the same for all of the 18 graphs. In some cases no mental age is available for reasons given under Table 1 and in the preceding paragraph.

Table 2 is derived from Table 1 and illustrated the data in a different way. For each child a distribution is made of the number of months in mental age each drawing is greater than, equal to, or

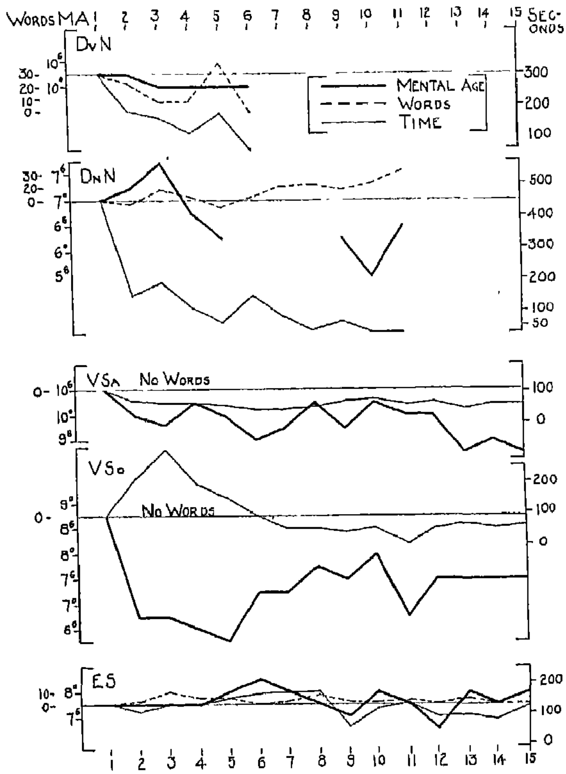

FIGURE 1c

less than the mental age rating of the first drawing. In brief, it gives the same data in tabular form which are visible in Figure 1 and computable from Table 1.

Pertinent observations from Tables 1 and 2 and from Figure 1 on the effect of induced frustration on the cognitive level of the children are summarized as follows:

1. Considering the 15 cases for whom calculations of mental age are possible, it is seen that 10 children showed a trend toward decreased mental ages as the experiment progressed; these are *RB, PD, RE, EH, SK, DvN, DnN, VSa, VSo, NS.* After her initial gain, *LC* also shows a slight trend toward decreased mental age. *FL, ES,* and *DT* showed very slight variations in both directions, while *ET* is

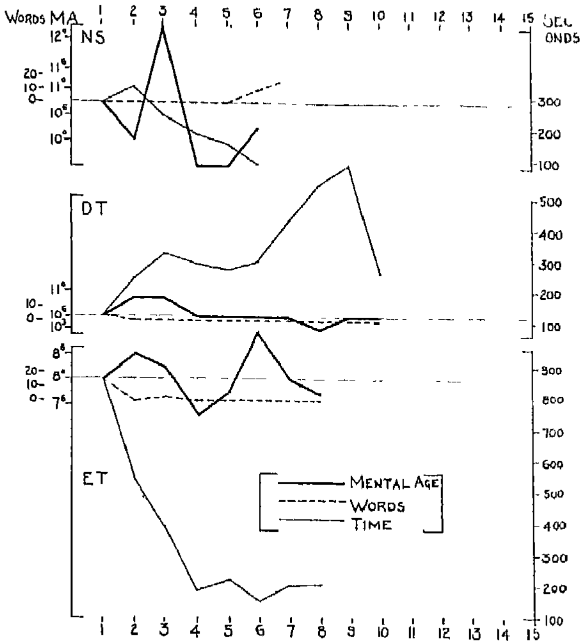

FIGURE 1d

extremely variable. No child showed a constant trend toward increased mental age. Of the three children whose mental ages were not computable, two probably should be rated as increasing their cognitive level since they drew more imaginative and complex pictures as the trials proceeded. An estimate for *IB* is impossible; her five pictures were unscorable due to omission of items deemed crucial by Goodenough and the inclusion of other items.[3]

2. Some of the children who showed an over-all decline in mental age as here scored weie very erratic. *DnN*, for example, first im-

[3]It is most unfortunate that *IB* could not be kept through 15 trials. As it was, she elaborated each man excessively, making whole pictorial scenes; she required over one hour to do five drawings. A nervous daughter of an eccentric woman who imagined herself a competent artist, *IB* was an ideal subject in many ways for this type of experiment. The experimenter stopped at five drawings because of her fatigue and partly because he was not in a position to be responsible for her should she break down while with him. Investigators in schools and clinics who have both staff and authority can carry some of these "neivous" children to the limit in the situation herein described.

TABLE 2

DEVIATION, IN UNITS OF THREE MONTHS OF MENTAL AGE, OF THE RATING OF EACH DRAWING IN COMPARISON WITH THE RATING OF THE FIRST DRAWING OF EACH CHILD UNDER STANDARD (GOODENOUGH) CONDITIONS

For each child the number of drawings of each degree of deviation is reported.

	Subjects*															
	RB	*LC*	*PD*	*RE*	*EH*	*SK*	*FL*	*DvN*	*DnN*	*VSa*	*VSo*	*ES*	*NS*	*DT*	*ET*	All
18				2									1			3
15																
12		3				1									1	5
9									2							2
6		3										1			1	5
3		1	1			2	1		1			5		2	1	14
0	*3*	*3*	*2*			*1*	*2*	*1*				*6*		*6*	*1*	*25*
—3		4	5	2		2	5	4	1	3		1		1	2	30
—6	1		1	1	1	2	5		1	4		1	1			18
—9						1	1		2	3	1		1		1	10
—12	1				2	1				2	1					7
—15	4					1				2	5		2			14
—18	3					3			1		2					9
—21	1															1
—24											3					3
—27	1				1						1					3
—30					1						1					2
—33					1											1
—36					2											2
—39					3											3
—42																—
—45					2											2
—48																—
—51					1											1

*Subjects *BB, IB,* and *BH* do not appear here because, as explained in the text, they had no ratings of mental age.

proved in quality, then lost rating, in Trials 6 and 8 made unmeasurable drawings (printed a name and insisted it was a man), in Trial 7 did excellent work, and finally, in three trials was very sub-standard. Child *SK* showed great gain in one trial but after that had a steady decline except in Trial 13. *ET* was characterized by great gains and losses; her curve is difficult to classify.

3. The general trend toward a decrease in cognitive level is also shown in Table 2. The median change is —4.0 months of mental age with the *Q*3 and *Q*1 points of the distribution being +.3 and —13.7 months, respectively. Only 29 out of 160 drawings show higher mental ages than the originals in their series. The average of the distribution of changes on mental ages is —7.0, s.d., 12.2

months. That it is considerably lower than the median is accounted for mainly by the behavior of *EH*. In the original detailed tabulations it is also apparent that, for those subjects who showed gains in mental age, most of the gains were in the early trials.

4. Changes in cognitive level not revealed by Goodenough measurements are also important. Some of the children changed their drawings so markedly that they were unscorable. Some older children began to tell stories with their pictures. In the appended case histories thumbnail descriptions of the drawings of several subjects are given. See especially the case of *BH*. These children were elaborating the task considerably, which, one can assume, is evidence of increased mental activity. That is to say, some children reacted to frustration by setting up self-imposed tasks which were more interesting than that determined for them by the experimenter. For some the addition of undemanded items (drawing a tree, bed of flowers, a street scene) may have been "going out of the field." For others, it may have been an honest attempt to make a better picture.

E. Changes in Attitude: Time Spent on Drawings

In Figure 1 the curves of time and number of words are helpful in objectively evaluating changes in attitude of the subjects toward their tasks. The data for these curves are given in Tables 3 and 4. Under ordinary life situations with normally high motivation one would expect the subjects to spend more time on successive drawings, at least for a few trials, to improve their quality. Certainly in the ordinary school more time is to be expended on a task if one fails to meet the standards. One "tries harder."

The following is a summary of the time curves in Figure 1:

1. Decreasing time.
   a. Quite regular and considerable in extent: *RB*, *PD*, *EH*, *DvN*, *DnN*, *NS*, *ET*.
   b. Quite regular, but slight in extent: *LC*, *SK*, *FL*, *VSa*.
2. Practically no change, slightly irregular: *ES*.
3. Increasing time: *BB*, *DT*.
4. Erratic time: *RE*, *BH*, *VSo*, *IB*.

One might expect that through practice the children could produce the required man in less time after completing each preceding one.

TABLE 3

NUMBER OF SECONDS REQUIRED TO PRODUCE THE FIGURE OF A MAN IN EACH TRIAL, MEASURED FROM THE GIVING OF INSTRUCTIONS FOR THE TRIAL UNTIL THE CHILD RETURNED THE PAPER

		Trials														
Subjects		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	*RB***	240	180	60	120	60	60	120	60	75	60	50	45	70	30	15
2.	*BB**	160	270	350	285											
3.	*IB*	655	900	330	240	360										
4.	*LC**	180	240	180	180	165	215	165	130	120	100	65	80	60	80	100
5.	*PD***	480	180	240	180	180	120	180	120	60	60					
6.	*RE**	300	240	370	255	210	305	300	340	270	310	255	370	540		
7.	*EH*	215	120	190	120	150	150	160	110	120	65	110	90	65	100	40
8.	*BH*	420	470	420	710	610	455	470								
9.	*SK**	150	90	60	70	110	73	95	40	40	83	40	28	53	45	
10.	*FL**	170	135	145	115	95	120	105	130	145	145	85	105	105	85	105
11.	*DvN*	300	180	160	110	180	60									
12.	*DnN*	450	150	195	110	60	150	80	40	60	30	30				
13.	*VSa**	105	70	67	65	55	50	50	55	72	70	60	65	50	60	60
14.	*VSo**	90	210	300	190	145	90	50	55	45	55	8	50	65	50	55
15.	*ES**	130	110	130	130	150	165	170	170	60	120	135	95	100	85	120
16.	*NS**	280	325	245	180	145	90									
17.	*DT*	120	240	320	290	275	300	430	535	610						
18.	*ET*	860	530	390	195	225	160	200	210							

**In these cases time was kept only in whole minutes.
*Clinic children.

TABLE 4

NUMBER OF WORDS SPOKEN IN EACH DRAWING TRIAL BY EACH CHILD

		Trials														
Subjects		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	*RB*	57	101	35	57	37	47	42	74	69	29	24	28	21	22	20
2.	*BB**	7	10	2	10	16										
3.	*IB*	46	8	14	0	0										
4.	*LC**	7	1	9	5	16	0	9	0	0	0	0	4	0	6	
5.	*PD*	65	28	14	28	49	35	20	11	27	24					
6.	*RE**	25	3	9	10	2	13	0	1	0	0	6	3	0		
7.	*EH*	14	4	22	28	31	45	29	34	26	27	31	29	35	33	16
8.	*BH*	5	0	0	0	0	0	0								
9.	*SK**	11	18	9	5	0	2	9	0	7	0	0	0	0	0	
10.	*FL**	8	14	17	3	2	4	1	1	4	11	10	24	1		
11.	*DvN*	31	24	9	8	38	0									
12.	*DnN*	10	7	18	13	6	14	20	22	18	22	32				
13.	*VSa**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14.	*VSo**	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15.	*ES**	0	1	11	4	5	1	2	7	3	2	3	0	5	0	0
16.	*NS**	0	0	0	0	0	7	19								
17.	*DT*	4	0	0	0	0	0	0	0	0						
18.	*ET*	17	0	1	0	0	0	0	0							

*Clinic children.

If an increase in efficiency were the explanation of the tendency toward reduced times, one would also have to find appreciably constant, if not rising, mental ages, which tendency, it has been shown, is not typical.

In some cases, notably *VSo*, Trials 2, 3, and 4, longer drawing times appeared along with severe losses in quality of the drawing. In the case of *ET*, whose time curve fell steadily, there were great variations in mental age as measured, the range being 21 months. More extremely, *NS*, with a small change in time, had a variation from Trials 3 to 4 of 33 months of mental age. *DT*'s time curve rose steadily from 120 seconds to 610 seconds, on Trial 9, with practically no change in mental age.

Altogether, 16 of the 18 children showed either a decrease in time or mental age, or both. While there is considerable evidence of more trial-to-trial decreases than increases in both mental age and in time per drawing, the evidence is that the quality of the drawings, as measured by Goodenough standards, is not dependent upon the time of drawing.

The tendency for decreased time per drawing, and also the decreased mental ages, is interpreted as being due to a changed attitude toward the task as a result of the frustration cumulatively set up from trial to trial. Recognition of bad faith on the part of the experimenter who had invited him to a pleasant situation, growth of the feeling that he could not satisfy the requirements, and lack of access to the "key" to the situation are some of the factors which could have altered the child's behavior considerably. Some children, because no actual punishment other than the implied disapproval appeared, may have lost their motive to do well or at least did not feel constrained to stay within the narrowly defined field of action.

IB's extreme variation in her five trials were due to a changed attitude. From the protocol one can note that she tried harder to please on Trial 2; she actually spent over eight minutes on her drawing and then proceeded to draw another which she submitted as her trial. On Trial 3, she was frustrated; she said *"Oh, I can't"* . . . *"These pencils are going down"* (meaning becoming dull), and post-experimentally she was not sure what it was a picture of, although she had distinct "stories" to accompany her other drawings. On Trials 4 and 5 she said nothing and worked fast.

ET's steep decrease in time per drawing is related to a different class of evidence of frustration. As later reported in this paper and in the appendix, she showed excessive physiological disturbances requiring special care.

In other cases, the reduction in time was associated closely with increases in verbal aggression. This matter is discussed in the next section.

Decreases in time per drawing might have occurred because of satiation, but it is difficult to believe that satiation was the main variable producing those curves in which considerable decrease in time is evident even in the second and third trials. The term satiation must imply some degree of repetition, at least beyond two or three trials. Some of the curves show great declination after Trial 1.

RB, *PD*, and *DnN* not only showed early and great decreases of time, but also were among the most aggressively resistant children, as shown in the section of verbal behavior. Time per drawing declined rapidly in the first three trials; resistant behavior, verbally expressed, typically surged upward after the third trial. The "words spoken" curves, dotted lines in Figure 1, do not reveal the relation because fewer words expressing more vigorous aggressiveness might have been used in some trials. This was especially true of *RB* and *PD*.

EH decreased steadily in time per drawing, although the slope of her curve is less than of the children just mentioned. Her verbal behavior was about the most aggressively resistant of all the children.

Other children, because of high standards and self-discipline, would not reveal frustration through decreases in time per drawing. They may not have been sufficiently frustrated by the experiment or their behavior may be interpreted as more adequate reaction to frustration. It had been expected that some children would continue expending time in an effort to meet the imposed demand, that some children might actually try to achieve finer artistic productions. In some cases, increase in time, on given drawings, might have been due to the child drawing irrelevant details; that is, the child "left the field" by drawing all sorts of non-man items.

BB, a clinic case and the oldest subject, was one of the three cases who refused to continue. She apparently tried to meet the demands;

Trials 2, 3, and 4 required longer times than Trial 1. On Trial 5 she balked and began to cry. The experiment was terminated. She obviously was frustrated.

DT showed the most definite tendency to increase time per drawing. She honestly tried hard. Knowing her background, the writers are certain that she had no other choice than to try and try to meet the experimenter's demands. She is described in more detail in the later pages of this paper.

The complete discussion of verbal behavior follows, but mention should be made here regarding the relation of verbal responses to time. The comparatively longer times on some individual drawings of most of the subjects and the general tendency toward increased time in *BB* and *DT* were not due to greater amounts of time being consumed in talking with the experimenter. Although no correlations have been run, one can see from comparison of data in Tables 3 and 4, and the dot and dash lines in Figure 1, that there was no tendency for children to require longer total times in those trials wherein they talked most. In fact, if actual *drawing* times rather than trial times had been kept, still more radical declines in time per drawing would have been noted, since in the protocols, it is evident that later in the series of each child there was a longer latent period before the child actually put his pencil to work on the drawings.

During the latent period, which was not measured exactly but was logged by the observer, there were at least these kinds of activities: aggressive speech; lack of "ability" to start, a sort of blocking; irrelevant drawing; planning activity, as if seeking for a mental solution before drawing. Much covert behavior of an aggressive nature must have been going on. Many gross and detailed body movements appeared.

F. Changes in Attitude as Measured by Conversation

In Figure 1 are also plotted the curves of number of words spoken by the children per trial; the data are in Table 4. Some children said nothing or practically nothing although there was no announced ban on vocal responses. The fact that these otherwise loquatious children who just previously had been engaged in familiar and bantering conversation, for the most part, now said so little is interesting.

Especially is it worthwhile to probe into the small amount of verbal

response of *DT*, who is a regular chatterbox and who is extremely curious about almost anything that affects her, even to the point of being classed as a suspicious child. Perhaps, as with her sister *ET*, the Canadian school system's stern discipline, coupled with a family standard of friendly but strict obedience, account for a change after the first trial. After Trial 1, the task became more school-like and less play-like; therefore, the change in behavior. The situation became anxiety-laden.

The curves do not tell the whole story. One child might not have said a word which would reveal aggressive reactions to frustration yet might have shown other definite signs of such attitudes. It is quite likely that the children who could talk freely actually were better off physiologically and emotionally at the end of the session. *RB*, *PD*, and *EH*, close friends of the experimenter, talked freely and steadily, even threatening (*RB*) to shoot the experimenter. Although the task was frustrating, and progressively more so, they came out of the situation at the end relatively happy and friendly because, it is believed, they could vent their aggression in threatening (but really harmless) verbal ways.

In general the clinical cases said less, the one exception being *RE*. *BB* talked some, but her words mainly involved her refusal to continue on Trials 4 and 5. This silence of the clinical cases was perhaps not due to their being "problem children" but to the fact that their relations with the experimenter, well planned as they were, approached the customary teacher-pupil relation wherein the child takes orders with docility.

An attempt was made to analyze the contents of the conversations on a qualitative basis. Table 5 gives the classification used and examples. It is difficult to classify sentences reliably out of their setting. It was even a problem for the experimenters, who had heard these children and had kept careful notes, to classify the sentences. The two authors went over each case, trial by trial, and agreed upon the classification of each sentence. Because most of the confusion leading to unreliability occurred in three proposed categories, here labelled *Dx*, *Dy*, and *Dz*, it was decided to consider them as subtypes of the general category of sentences giving evidence of resistance. Exclamatory phrases (such as "*Oh gosh!*") standing alone were called sentences; if they were followed at once by a "qualifying"

TABLE 5

CATEGORIES FOR CLASSIFYING SENTENCES WITH ILLUSTRATIONS

A. Factual, Informative, Inquiring, Exclamatory Sentences
I'm going to sneeze . . . A man? A farmer? . . . Can you draw small if you want to? . . . Finished . . . O.K. . . . Tinkers! this hat I'm making is a Dutch hat . . . A bigger one, I guess . . . Can you put anything else on it? . . . All right . . . A picture of a man. A picture of a man, this time a better one . . . Hey! one button, two button, three button, I make . . .

B. Self Deprecatory Sentences
I can't draw very well . . . This isn't my best, but . . . Oh you got me stuck on that one . . . I can't draw no better.

C. Self Laudatory Sentences
I can draw a good little girl.

Dx. Sentences Exhibiting Resistant Behavior. Mild, Severe Verbal Aggression
(Some sentences in this category may seem, in isolation, to be simple declarative sentences or questions, but in their context they are obviously aggressive in intent. Cases in the appendix supply illustrations.) That's all, I'm done . . . I know a trick that's being played on me . . . All right, but I wonder . . . I won't make a good one . . . There, does that set aside (satisfy) you? . . . I'm not trying to make it good because you're going to make me make another one. If this one isn't good enough you'll have to lump it . . . If you tell me to make another I'll shoot you . . . Hey! No, No, No . . . Cut it out . . .

Dy. Sentences Exhibiting Resistant Behavior: Vaguely or Specifically Demanding a Termination of Experiment
How many men do you have to draw? . . . Do I have to use all these sheets? . . . (Will you draw this last one?) Honest? Honest? Honest? . . . All right, this is the last one. Two more and I get through . . . When am I going to get through, next week? . . . The last one. Don't forget.

Dz. Sentences Exhibiting Resistant Behavior: Going Out of the Field and Other Evasive Expressions
I'll make a picture of a house . . . (singing) I remember when I rode (wrote) my pencil, the night when I rode my pencil . . . I can hear someone talking (no one present) . . . He's calling me. He wants me. Look me in the window . . . After, Junior is going to draw . . . Poor kid is tired (meaning self) . . . Someone said "David" by the door (fiction) . . . I'll bet you a nickel someone is there. Wanna see?

remark (as *"Oh gosh! I forgot the ears."*) they were not counted as separate sentences. The writers tended to force items into Category *A*, even if they were fairly sure a sentence was more an emotional expression than a simple question or declaration.

Table 6 contains the data for each subject with totals for the group at the bottom. About one-half of the sentences are in Category *A*. A very few are self-judgmental, Categories *B* and *C*. About 40 per cent are classed as expressions of resistance to the experimenter or the task. Sub-type *Dx*, mild and severe verbal aggression, is the most common.

TABLE 6
NUMBER OF SENTENCES IN EACH OF SIX CATEGORIES SPOKEN BY EACH CHILD

Subjects	*A*	*B*	*C*	*Dx*	*Dy*	*Dz*
RB	62	7		32	5	14
*BB**		8		1		
IB	16	1				1
*LC**	10	1				1
PD	28	1		22	5	9
RE+	15	2	1	1		
EH	27	2		33	19	
BH	1					
*SK**	6	2	1	1		
FL+	26			1	1	
DvN	10	2		3	3	4
DnN	5	1		14	11	4
*VSa**	12					
*VSo**	1					
*ES**	14			2		
*NS**	5			6		
DT	1					
ET	4					
All	243	27	2	116	42	33
%	52	6		25	9	7

*Clinic children.

Individual differences both in the number of sentences and their classifications are apparent. *IB* and *FL*, for example, sought information and made casual remarks. When *DnN* talked he was likely to be resistant to the experimenter and the task. *RB*, the experimenter's sister, and *EH*, a close friend, not only talked much, but felt freer to voice their resistance. *RB* attempted frequently to leave the field and shift responsibility.

In Table 7 there is a breakdown of the sentences of those cases who talked most or showed a high proportion of resistant behavior to reveal on which trials the different attitudes were expressed. It is apparent, even by casual observation, that there was a tendency for early trials to be characterized by informative and questioning sentences while later trials, beginning around Trial 3 and 4, were filled, if there was talking at all, with more resistant behavior.

It appears, then, that through analysis of the content of children's conversations we have a measure of their changing attitude toward the experimenter and the task. Technically there should be a control study of these children in other relations to determine individual differences in ability or willingness to carry on conversation without

TABLE 7
TRIAL-BY-TRIAL DISTRIBUTION OF SENTENCES OF EACH CATEGORY FOR SIX CHILDREN WHO, AS SEEN IN TABLE 6, SHOWED MOST RELATIVE RESISTANT VERBAL BEHAVIOR

Subjects	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RB	10a	21a	2a	3a		5a	4a	5a	4a	2a	2a	3a			1a
		1b	2b	2b			2b								
			3dx	4dx	2dx	2dx		3dx	7dx		2dx	1dx	2dx	2dx	4dx
				1dy	1dy					1dy			1dy	1dy	
					1dz	2dz	2dz	3dz		1dz	1dz	1dz	2dz	1dz	
PD	17a	6a	2a	1a	1a		1a								
					1b										
				1dx	5dx	2dx	2dx	4dx	4dx	4dx					
				1dy		3dy	1dy								
				4dz			1dz	1dz		3dz					
EH	2a		4a	4a	1a	5a	1a	1a	1a	1a	2a	3a		2a	
		1b		1b											
					3dx	2dx	2dx	4dx	4dx	3dx	3dx	3dx	5dx	2dx	2dx
					2dy	3dy	2dy	2dy	2dy		4dy			2dy	2dy
DvN	5a	3a	1a		1a										
	1b	1b													
					2dx	1dx									
			1dy	1dy		1dy									
					3dz	1dz									
DnN	1a					2a		1a	1a						
	1b														
			2dx			2dx	1dx	1dx	2dx	4dx	2dx				
			2dy	1dy			2dy	2dy		1dy	3dy				
				1dz	1dx	1dz					1dz				
NS	1a	1a	1a	1a	1a	2dx	4dx								

leading remarks being made by the experimenter. For instance, the clinical children "could not" converse; but one cannot conclude that the reason lies just in the fact that they were clinical children. In and of itself, the making of conversation provides one important way in which children can react to frustration.

G. SUMMARY OF THE EXPERIMENTAL DATA

The objective analysis of the data took three directions, summarized below. No particular summarization of the physiological symptoms of reaction to frustration is made, although occasional references have been made and further comments are found in the case descriptions in the appendix. A few notes regarding post-experimental conversations are given in the cases in the appendix.

1. *Changes in Cognition*

There was a general tendency for a lowering of cognitive level as measured in terms of changes in mental age determined by the Goodenough scale. Individual differences occurred. Non-scorable drawings often showed complexities which could be interpreted as heightening of the cognitive level (drawing pictures with elaborate stories) or as attempts to leave the psychological field (writing names and adding a row of flowers).

2. *Changes in Attitude: Time Changes*

Decrease of time spent on each drawing seems to have been general enough to merit noting as a trend. This decrease was not due to increased efficiency but is interpreted here as a reaction to frustration. It is thought not to be satiation, since the sharpest decrements of time came early, before satiation could have set in. Individual differences occurred; some children seemed to be seriously putting in more time in order to meet the imposed demands. Verbal behavior verified that some of the briefest drawing times were out-and-out aggressive reactions against the experimenter.

3. *Changes in Attitude: Verbal Behavior*

About 40 per cent of the sentences were classed as having shown positive evidence of resistance to the experimenter and the task. These resistive statements were not found in early trials but began around Trial 3 or 4 and increased in their prevalence as time went on. Samples of the contents are given both in the text and in the case histories in the appendix. Some children said little. In clinical cases this non-verbal behavior might have been due to the kind of teacher-pupil rapport set up. In the case of one close friend, where little was said, the physiological consequences lead the writers to believe that she would have been less tense and disturbed had she felt free to talk. The three most talkative children were intimate friends of the experimenter.

H. Discussion of the Results

In the following sections, the writers analyze some aspects of their data in relation to work done by others, not in experimental detail but more in relation to theory and conclusions.

1. *Classification of Expected Behavior*

Based upon current literature, chiefly that of Lewin (8), Dollard, *et al* (3), and Rosenzweig (13), the following sketch of what could be expected in the situation was constructed. Specific data in the text and appendix provide illustrative material of the systematic adequacy of the outline. The experiment was not set up to probe into *I, B,* 2 or II, *B,* 2.

I. *Overt behavior, both physical and verbal.*
  A. Direct—against the person who is in control of the frustrating situation or against objects which are causes of the frustration.
    1. Seeking an honorable end to the situation.
      a. Definitely constructive plan of action.
      b. Evasive behavior, "going out of the field."
    2. Anger behavior in varying degree.
  B. Indirect—against any other person or object closely or remotely related to the frustrating situation (displaced aggression).
    1. Intra-situational—against objects, self, or persons coincidental to the frustrating situation.
    2. Extra-situational—against objects or persons outside the situation, i.e., after the immediate frustrating situation has ceased. (In the case of long continuing frustrations, of course, all events in the person's life become intra-situational.)

II. *Covert behavior*—behavior, including some verbal and motor behavior, which is made meaningful for the observer and the subject only after considerable analysis and from post-experimental observation. (Change in form of aggression.)
  A. Disguised but expressed reactions to frustration—symbolic content of overt activity superficially quite unrelated to the frustrating situation but easily revealed to be significant through simple questioning.
  B. Repressed thought
    1. Content discoverable with questions as to attitude.
    2. Content so repressed that normal interview techniques yield no useful data.

2. *Frustration Tolerance*

That persons when frustrated show different degrees of tolerance, broadly defined, is commonplace. In an automobile accident, two

persons in the non-offending car get out hurriedly. One blows up, becomes vehement and profane; the other remains objective, calm, non-judgmental. An important practical problem of parents, teachers is to discover how frustration tolerance can be established. J. B. Morgan (9) says that ability to tolerate discomfort is a sign of emotional maturity.

Frustration tolerance is defined by Rosenzweig (13), as follows: ". . . The capacity of the individual to withstand a given frustrating situation without distorting the so-called 'objective' facts of the life situation."

This idea is also elaborated by Mowrer (12), in his discussion of the impoitance of recognizing that frustration is more than a disagreeable state of being; it is a necessary condition in the process of socialization of the child. The term tolerance is not used, but obviously in the socialization process we are concerned with a process of learning wherein goals which were once highly desired and insisted upon are now lower in the hierarchy of demand and other goals which were of little force are now potent in the everyday life of the socialized individual. "The central problem in these fields today is how can children be educated for modern life, adequately and efficiently, yet with the minimum of danger to the present as well as future integrity of their personalities." In attempting to understand the development of individual personalities, one needs to be aware of continuous frustrations, ". . . those more or less permanent renunciations which are demanded of all members of a group as the price they must pay for the gains of social living . . . (Freud) . . . 'culture privations . . .' "

There is no reason to believe that persons develop generalized tolerance for frustration; the work on character by Hartshore and May (5), and others, suggests that tolerance of social rules is not a general trait. Persons who have low tolerance in some fields may have high tolerance in other situations.

In the present experiment four cases, partially described earlier, provide interesting sidelights on tolerance of frustration.

The case of *RB* is interesting because she is the sister of the experimenter. This intimate relationship alters considerably the pattern of behavior which can be interpreted as being tolerance of frustration. Her conversation is presented in detail in the appendix. In brief, this

girl was loquatious; she talked on all topics; she called the experimenter derogatory names; she threatened, childishly of course, to kill him; she sought reasons for terminating the job; and, although she kept on doing the task, thus showing high tolerance, she probably continued mainly because she knew her brother would do her no harm and that his love and affection really were not at stake. Her tolerance, measured verbally, was low; her tolerance, measured in acts of drawing, was high.

BH is very mature for her age. She has been brought up to be independent; discipline has been understood by her and is highly rational; she often disciplines herself when her bad judgment has caused some serious error. She has been in good schools, the best of progressive education's attempts, and shows no reticence whatever in her relations with adults. She ate dinner often with the experimenter at a summer hotel and maintained a high level conversation on such subjects as war and *"Is the world getting better?"*, by the hour. In short, she is self-disciplined, emotionally mature and secure. Her tolerance for the task imposed upon her was high. She admitted later worrying about what the task was all about. Asked why she did not take the easy way out of the job, namely, by drawing poorer pictures rapidly, or by refusing to continue, she answered, *"I couldn't do that,"* in a tone which implied high self-imposed standards of obligation. She had promised to come and draw and she "had to" draw well no matter what happened. She had self-respect. She also wanted respect from others. She sought out the experimenter often on the camp grounds; she was in his recreational classes; she lived in the same cottage with one of the experimenters. She told her parents it was a hard job but she did just as well as she could and was satisfied. In Rosenzweig's terms, her behavior was direct, adequate, perseverative, and specific; she showed a very high level of toleration for the repeated inference that she was failing and must draw a better man. Other items in her behavior are reported elsewhere in this paper; descriptions of her pictures are in the appendix.

ET, whose high tension after the experiment is described in the appendix, is an example of a girl whose tolerance for situations has been made high through her attendance in a strict school system (Canadian) supported by high pressure from her parents for obedience to teachers and superiors. The family does not use physical pun-

ishment but emphatically stresses the importance of high academic achievement and personal conduct for self and for family. She was *externally* very tolerant. We could have insulted her tremendously without her showing any anger-like resistance. She was extremely docile. Doubtless she thought the experimenter was right and she was wrong. She tried to draw better. Observe in Figure 1 that the drawings did not improve. While her outward social obedience suggested high tolerance, her physiological breakdown tells a different story about her tolerance for frustration. If hers were a background of lightheartedness and humor about school tasks and also of permission to talk freely with superiors, (She said four words in Trial 1 and not a further word for one hour!) this physiological reaction probably would not have occurred.

BB, a clinical case, drew four pictures and on the fifth demand refused to draw any more. Her few spoken sentences were all self-deprecatory.

These cases suggest that no single type of evidence concerning reactions to frustrations can be expected. Before measures of tolerance can be deveolped, there must be clear recognition that separate measures will have to be worked out along a variety of reaction patterns which can be expected. It seems almost hopeless at present, for example, to equate the tolerance to frustration ending in anger reaction after 10 minutes of frustration and the tolerance of frustration ending in a fit of crying or in evasive humor after 10 minutes.

3. *Fitting the Experiment into Rosenzweig's Types of Reaction*

Rosenzweig (13), in a summary paper for a symposium on frustration, has organized the following systematic outline of the types of reaction to frustration. Under each type his meaning is stated briefly and then examples are presented to show whether the present data fit into the scheme.

a. Adequate and inadequate. All reactions are adjustive. Those which are close to facts of reality and are progressive rather than retrogressive in terms of growth of personality are adequate reactions. Of course, from the view of the reactor, many inadequate reactions are not recognized as being that.

Inadequate reaction among the subjects include, as typical material, the following: A girl who created an imaginary person who called her away from the drawing. A boy who said he would draw a

man and then just printed his brother's name and insisted it was a man. Examples of adequate reactions: all of the attempts to really produce a better man, both anatomically and artistically.

b. Direct and indirect. The same idea has been presented in a preceding section under the headings of indirect and direct overt reactions.

c. Defensive and perseverative. Defensive reactions have at their core the integrity of the ego. Perseverative reactions have as their function the obtaining of ultimate satisfaction for the frustrated need in spite of the immediate impasse. Anger and refusal to continue, in their various modes of expression, are defensive; the subject gives up the need for the goal and reacts in terms of immediate need for ego satisfaction. The present experiment showed several cases of defensive reactions, of running away from the need for the approval of the experimenter and for gaining this through better drawings.

Perseverative reactions were observed in the case, for example, of *BH* who continued to draw better and better pictures, taking upon herself the responsibility for not having done better. She persevered *in the situation* and *on the precise task* in her striving for recognition from the experimenter. Other cases likewise showed straight-forward evidence of attempting to continue at this task until their needs were satisfied through meeting the higher standard continuously imposed.

Under defensive reactions, Rosenzweig detects three sub-groups: intropunitive, extropunitive, and impunitive. Although his illustrations are from abnormal fields, there is reason to believe that similar modes of response on a simpler level are found among these children. For example, there were children who blamed themselves (intropunitive); those who blamed the materials, outside forces, teachers, etc., (extropunitive); and those who "skipped" the job by humor, refusing to take the matter seriously, a "just-can't-be-helped" attitude (impunitive).

d. Specific and non-specific. The non-specific reactions referred to are those which are more strictly physiological, such as falling asleep, becoming fatigued. The reaction is widespread and does not bear only upon the reactions to the frustration but to all other stimulating situations then operating. For example, the "neurotic pigs" of Curtis (2) were responding to frustrating conditions in one field, namely,

food-getting, by widespread physiological breakdown involving moie than feeding reactions. Our study did not push the frustration far enough to obtain many out-and-out reactions of this non-specific sort. That such would be expected is shown by the breakdown in speech and in the quivering of the whole body by *ET*, as reported in detail elsewhere in this article. *BB* refused after four drawings and cried.

This review of Rosenzweig's scheme is presented to make clear that here is a procedure which yields results much in keeping with his outline which, as one quickly gleans, has been developed through his work mainly with neurotic and psychotic patients and with considerable reference to the psychoanalytic literature.

I. Appendix

1. *PD, Female, 5 Yrs., Neighborhood Friend*[5]

Trial 1: "Draw the picture of a man. Draw the very best picture that you can." "What first I make? I make the head first?" "Draw the picture of a man. Draw the very best picture that you can " "Any man?" "Draw the picture of a man. Draw the very best picture that you can." "I'll make it this way. Any way all right? With buttons, huh? I can make eyes the best that I could. Have you got an eraser? I like this pencil more better. Junior, he's waiting out for me. The legs, too? A big one, huh? Anyway, huh? Best. Anyway that I can make. That's all. There!" Time 2:00. *MA* 6 yrs., 6 mo.

Trial 2· "Draw the picture of a man. Draw the very best picture that you can." "Hey! Button, three buttons I make. His gloves I make. He got one glove on and he lost the other. Shall I make the ear?" "Draw the very best picture that you can." "That's one ear." Time 2:00. *MA* 6 yrs., 9 mo.

Trial 3: "Draw the picture of a man. Draw the very best picture that you can." "All right, this gonna be a pretty one. There, see how many I make?" Time 3:00. *MA* 6 yıs , 6 mo.

Trial 4: "Draw the picture of a man. Draw the very best picture that you can." "Oh, you say that. He's calling me. He wants me Look me in the window. After, Junior is going to draw. I got to finish all that paper? There!" Time 2.00. *MA* 6 yrs., 3 mo.

Trial 5: "Draw the picture—" "I know, I gotta draw a man, the best one that I could. Always make a man, not a girl. Oh, Gee winig! I like to finish." After a moment of work "What a big one. I don't know what to do. I see so mad! There, that's the best one I can do." Time 2:00. *MA* 6 yrs., 3 mo.

[5]*RB* and *PD* were the first two cases studied. Time was kept in whole minutes. Instructions on drawings after the first trial were the same as on the first trial; in subsequent cases the term 'better' was employed as described in the text.

Trial 6: "Draw the picture of a man. Draw the very best picture that you can." "How many I got to draw? When I get through, when I get through?" "Won't you draw this last one?" "All right, this is the last one. Two more and I get through." Handing in the paper, "There, that's the best one that I can make." Time 1:00. *MA* 6 yrs., 6 mo.

Trial 7: "Draw the picture of a man. Draw the very best picture that you can." "Two more. You always say that. I'm going to take this pencil now. Silver Pencil. There, that's best one." Time 2:00. *MA* 6 yrs., 3 mo.

Trial 8. "Draw the picture of a man. Draw the very best picture that you can." "I'm almost tired. I'm doing it fast. That's the best one. Hey, no more. I wanna do no more." Time 1.00. *MA* 6 yrs., 3 mo.

Trial 9: "Won't you draw this last one?" "When I'm going to get through, next week?" "Won't you draw this last one?" "All right, the last one. Don't forget. Last one. That's last one." Time :40. *MA* 6 yrs., 3 mo.

Trial 10: "Draw the picture of a man. Draw the very best picture that you can." "Hey! No, no, no." "Won't you draw this last one?" "All right, last one, but no more. I'm tired. No more. Poor kid is tired. That's the last one. I'm tired." Time :30. *MA* 6 yrs., 0 mo.

2. *RB, Female, 6 Yrs., Sister of Experimenter*

Trial 1: "Draw the picture of a man. Draw the very best picture that you can." "Shall I mark my name on the bottom after?" "Draw the picture of a man. Draw the very best picture that you can" Talks profusely as she works, "Stomach. Had to make his hair, har, hair, har, hair, har, hair, hair, hair. Here's the other hand. Now I've got to make his feet. Got to make his hands This looks like a boy Here's his hat." Time 4·00. *MA* 7 yrs., 9 mo.

Trial 2: "Draw the picture of a man. Draw the very best picture that you can." "Oh, another man? That's a boy, all right, I'll make a man. There's not many pencils here. I've got to make a man. Eyebrows. I'll make him nice. This looks like a man. The other was supposed to be a man, but I made a boy. Here's a man that you never saw. He's frightened. Look at him. O.K. Can I make his neck? I'm just ready to make his feet. Oh, lookit. Lookit his stomach. Well, let it be, he's still a man. He's putting his hands up. Three, four five. His hands are up. Here's the ground; here's the sky" Time 3.00. *MA* 7 yrs., 9 mo.

Trial 3 "Draw the picture of a man. Draw the very best picture that you can." "Another man? Oh, oh, oh, oh! I must make it cleaner. I didn't have the stomach right, that's why. Big eye, bigger eye, little mouth. There, I hope that's big enough. Feet, feet, grass, sky." Time 1·00. *MA* 7 yrs., 9 mo.

Trial 4: "Draw the picture of a man. Draw the very best picture that you can." "Oh, oh, oh! Another man. I made one, two, three, four. Four men already and I've got to make another one. Do I have to use all those

sheets?" "Draw the picture of a man. Draw the very best picture that you can." "I made something wrong. Here, oh! it's not right yet. I'll take this pencil. See, there's his leg, shoe, shoe—wup! I forgot to make his hair." Time 2:00. *MA* 6 yrs., 9 mo.

Trial 5: "Draw the picture of a man. Draw the very best picture that you can." "Alex! you're mean. I'm going to use this pencil today. I have to think. Who wrote? I did. (Improvises song) 'I remember when I rode on my pencil; that night when I rode on my pencil'. I can hear someone talking. There! (hands in paper) Does that herm (sic) you any better?" Time 1·00. *MA* 6 yrs., 6 mo.

Trial 6. "Draw the picture of a man. Draw the very best picture that you can." "Alex! You are being mean. I'll draw the picture of a house" "Draw the picture of a man Draw the very best picture that you can." "I'm not trying to make it good because I know you're going to make me make another one, and if this one isn't good enough you'll have to lump it." (As she hands paper in) "Do I have to make another one?" Time 1.00. *MA* 6 yrs., 6 mo.

Trial 7: "Draw the picture of a man. Draw the very best picture that you can." "Alex, I'm going to ask Tina for a glass of water." "Draw the picture of a man. Draw the very best picture that you can." "All right, I'll make a neat one. Here's the neatest I make. Telephone broke. Here. Oh, there's something wrong. I didn't make no hands on him either. It looks like a dress." Time 2:00. *MA* 7 yrs., 9 mo.

Trial 8: "Draw the picture of a man. Draw the very best picture that you can." "Oh my dear Alex! Dear me! I'm going to draw a house with him. I'm going to draw a house and a man. I'm going to draw no hair. I'll make a double cross nose, eyes, Tina, I think of you. Here's his stomach. He's sitting down on a chair, Alex. Here, it looks like a lady but it's a man. If you tell me to make another one, I am going to shoot you." Time 1:00. *MA* 6 yrs., 6 mo.

Trial 9. "Draw the picture of a man. Draw the very best picture that you can." "Oh, oh, Alex! I don't like this test. I don't think this is a very nice test. Not that I like it. Anybody would know that. Tum, tum, I'm making this fast man. One, two, three, four, one two, three, four. There—oh! I got to make another hand. There, does that set aside you? I'm not going to make another man if you want to know something." Time 1:00 *MA* 6 yrs., 3 mo.

Trial 10. "Draw the picture of a man. Draw the very best picture that you can." "Do I have to draw all those sheets up? I'm going to draw it this way. Uh, uh. Somebody—I'm going to make sky and grass." Time 1:00. *MA* 6 yrs., 3 mo.

Trial 11: "Draw the picture of a man. Draw the very best picture that you can." "Yah, I know! a man. Oh, Tina, save me. (Sings a song) 'Work, yes, work.' One, two, three, four, these are some of his buttons. Tuxedo coat." Time :40. *MA* 6 yrs., 0 mo.

Trial 12: "Draw the picture of a man. Draw the very best picture that

you can" "Oh, yah; oh, yah. Oh, this time I'm drawing a home. I make one, two, a three. Gee, I forgot how to make a stomach. Oh! there." Time :30. *MA* 6 yrs., 3 mo.

Trial 13: "Draw the picture of a man. Draw the very best picture that you can." "Can't I get a candy?" "Draw the picture of a man. Draw the very best one that you can." "I don't wanna." "Won't you draw this last one?" "Just this one?" "Yes." "I won't make a good one." Time :45. *MA* 5 yrs., 6 mo.

Trial 14: "Draw the picture of a man. Draw the very best picture that you can." "Gee! I gotta draw another one. Tina, bring me a candy. I gotto. (Handing paper in) Alex, do I have to draw another man?" Time :20. *MA* 7 yrs., 3 mo.

Trial 15: "Draw the picture of a man. Draw the very best one that you can." "All right. There's Santa Claus. Last one. This is the last one. I know a trick that's being played on me." Time :20. *MA* 6 yrs., 6 mo.

3. *BH, Female, 12 Yrs., 4 Mo., Summer Colony Friend*

Trial 1: "Can he be doing anything?" Time 7:00. The picture is of a man in a tennis outfit holding a tennis racquet over his head. *Post-experimental comment:* "Just tennis."

Trial 2: No verbal activity. Time 7:50. The picture is of an old man with a beard, one foot bandaged, leaning on a cane. *Post-experimental comment:* "It's an old man that's got a bad foot. I was reading about a grandfather who had a bad foot"

Trial 3: No verbal activity. Time 7:00. The picture is of a bald headed man standing behind a dentist's chair. *Post-experimental comment:* "That's a dentist. I can draw old men better than young men—it's harder to draw the hair on a young man."

Trial 4: No verbal activity. Time 11:50. The picture is of a minister with a long beard and gown, standing behind a podium. *Post-experimental comment:* "He's a minister."

Trial 5: No verbal activity. Time 10:10. The picture is of a runner breaking the tape. *Post-experimental comment:* "He's a runner. He won. More fun to have the end of the race; then you wouldn't have to think about it any more. *I was thinking of my job.*"

Trial 6: No verbal activity. Time 8:35. The picture is of a man putting a golf ball. *Post-experimental comment:* "I began this for a workman digging but it looked better with a golf club."

Trial 7: No verbal activity. Time 7:50. The picture is of the back view of a painter sitting on a scaffold. *Post-experimental comment:* "He's a painter. He's painting the outside of the window of an apartment house. That's putty to put in the window. We are going to have a new house and we got paper for it."

Mental ages could not be computed because of complexity; they probably were all over 13 years.

4. *EH, Female, 7 Yrs., Close Friend*

Trial 1: "Draw the picture of a man. Draw the very best picture that you can" "This will be a boy. Isn't that O.K.?" "Draw the picture of a man. Draw the very best picture that you can." Begins to draw with pronounced body movements She hands paper in saying to herself, "I think this is all finished." Time 3:35. *MA* 10 yrs, 0 mo.

Trial 2. "Draw another man; this time a better one." Looks surprised but says nothing. After working for a moment, "I couldn't do it." Time 2:00. *MA* 9 yrs., 6 mo.

Trial 3. "Draw another man; this time a better one." "Ha! Why are you doing those so much?" "Draw another man; this time a better one." "Ha, ha." After working a moment, "I know what were the matter with that other one" Time 3:10. *MA* 7 yrs, 9 mo.

Trial 4: "Draw another man; this time a better one." "Ho, ho. I don't know how to do it." "Draw another man; this time a better one." "What can I do?" "Draw another man; this time a better one." "Why can't I make a girl?" "Draw another man; this time a better one." "Ha, ha." Starts to hand the drawing in then takes it back, "Ooops! I forgot something." Time 2:00. *MA* 7 yrs., 6 mo.

Trial 5: (Before experimenter can give directions) "Are you going to make me draw another one?" "Draw another man; this time a better one." "I can't." "Draw another man this time a better one." "Ha, ha. I can't, honest, Mr. Bavelas." "Won't you draw this one?" "All right, one more. There, a different form." Time 2·30. *MA* 9 yrs., 0 mo.

Trial 6· "Draw another man; this time a better one." "I can't. I can't." "Draw another man; this time a better one." "Oh, yes, one thing I know. This looks sort of like a woman. It must be. Well, I can't. Are we going to do this once more? Are we? Wait, his feet All through." Time 2:30. *MA* 7 yrs., 0 mo.

Trial 7: (Before experimenter can give directions) "Oh, oh!" "Draw another man; this time a better one." "I knew you were going to ask me." "Draw another man; this time a better one." "Tell me is there going to be another one?" "Draw another man; this time a better one." "Tell me, please!" "Draw another man; this time a better one." "I know that's what you're telling me." (Meaning, "I know that's only what you're saying.") Time 2·40 *MA* 9 yrs., 0 mo.

Trial 8: "Draw another man; this time a better one" "Will you ask me again?" "Draw another man; this time a better one." "Oh, oh! I can't I can't draw another one" "Draw another man; this time a better one" "Why do you ask me to draw so many?" "Draw another man; this time a better one" "Why do you? Will this be the last one?" "Yes." "All right." Time 1:50. *MA* 6 yrs., 9 mo.

Trial 9: "Should I draw another one?" "Draw another man; this time a better one." "You told me! (Referring to answer of 'yes' to her question if the last drawing were the final one) You said it were the last one."

"Draw another man; this time a better one." "Mr. Bavelas! You said." "Draw another man; this time a better one." "Were this the last one?" "Yes." "All right." Time 2:00. *MA* 6 yrs., 3 mo.

Trial 10: "Now, what to draw?" "Draw another man; this time a better one." "You told me you weren't going to do any more." "Draw another man; this time a better one." "You told me you weren't." "Draw another man; this time a better one." "I'm . . . I'll . . . it weren't . . . I'll draw one more" Time 1.05. *MA* 5 yrs., 9 mo.

Trial 11: "Now?" (She still believes something pleasant would come after.) "Draw another man, this time a better one." "You told me you weren't going to make do any more." "Draw another man; this time a better one." "You told me you weren't." "Draw another man; this time a better one." "You said the other were the last one." "Won't you draw this last one for me?" "Honestly the last one?" "Yes." "Honestly?" "Yes." "Honestly?" "Yes." "Honestly?" "Yes." "All right." Time 1:50. *MA* 6 yrs., 9 mo.

Trial 12: "What should I draw now?" "Draw another man; this time a better one." "You said 'honestly' ". "Draw another man; this time a better one." "You said 'honest'." "Won't you draw this last one?" "All right I need a handkerchief." Returns in a moment. "I think I know what you're getting me up to" Time 1:30. *MA* 6 yrs., 9 mo.

Trial 13: "Draw another man; this time a better one." "Oh, dear. I know what you're up to" "Draw another man; this time a better one." "Why do you make me draw another one?" "Draw another man; this time a better one." "You said no more?" "Won't you draw this last one?" "I think I know what you're getting me up to." "Won't you draw this last one?" "All right, but I wonder." Time 1:05. *MA* 6 yrs., 3 mo.

Trial 14: "Draw another man; this time a better one" "You said!" "Draw another man; this time a better one." "Honestly the last one?" "Yes." "Honestly?" "Yes." "I'm thinking more and more you're going to keep me to finish the pack. Is this one 14 or 18? It looks like 14 or 18." Time 1:40. *MA* 7 yrs, 3 mo.

Trial 15: "Draw another man; this time a better one." "You said." "Draw another man; this time a better one" "Honestly will this be the last one?" "Yes." "You said lots of times 'yes'." "Draw another man; this time a better one." "Honestly?" "Yes." Time :40. *MA* 7 yrs, 0 mo.

5. *DnN, Male, 6 Yrs., 1 Mo., Member of Experimenter's Recreation Club*

Trial 1: "Draw the picture of a man. Make the very best picture that you can." Begins. Draws a head, stops, scratches his head with the pencil, erases, then squints up at me and says, "I can't make good heads. Is there any college boys?" (Curiosity about being in college psychological laboratory). Begins to draw again. Stops and watches the experimenter for about ten seconds, then erases all and begins another picture. Time 7:30. *MA* 7 yrs.

Trial 2: "Draw another man; this time a better one." Looks surprised, says nothing but begins to draw. Time 2:40. *MA* 7 yrs., 3 mo

Trial 3: "Draw another man; this time a better one." "How many men?" "Draw another man; this time a better one." "Shall I make another one after?" "Draw another man; this time a better one." Begins and works for about two minutes, then, "This time I'll make a picture of you!" Hands drawing in saying, "Now, is there anything wrong with that?" Time 3:15. *MA* 7 yrs., 9 mo.

Trial 4: "Draw another man; this time a better one." "How *many* men?" "Draw another man; this time a better one." "Hey, after can I write some words?" "Draw another man; this time a better one." Makes drawing without further comment. Time 1:50. *MA* 6 yrs., 9 mo.

Trial 5: "Draw another man; this time a better one." "Can I draw a word sometimes?" "Draw another man; this time a better one." Looks questioningly but begins to draw, resting his head upon the table. Time 1:00. *MA* 6 yrs., 3 mo.

Trial 6: "Draw another man; this time a better one." "Now can I draw a letter?" "Draw another man; this time a better one." "Gee!" Draws a large circle on his paper, exclaims, "Wup!" and erases it. Hides paper with his arm so experimenter can't see what he is drawing. Whispers to himself as though counting or spelling. Hands in paper, laughing, "There that's a man! That's writing!" Time 2:30. *MA* not scorable since he only had printed his brother's name (DICK).

Trial 7: "Draw another man; this time a better one." Smiles and begins. Looks up and says, smiling, "Dick is a man; don't you know that?" (He is obviously referring to his last drawing and justifying his writing of the name 'Dick' rather than drawing a man.) He looks up again after a minute, "Do I have to draw after this?" "Draw another man; this time a better one." "Do I have to draw after that?" "Draw another man; this time a better one." Time 1:20. *MA* 7 yrs., 9 mo.

Trial 8: "Draw another man; this time a better one." "Hey! when I'm going to finishing? Am I going to stop?" "Draw another man; this time a better one." "I'm going to copy that picture." Points at calendar on the wall. He begins but uses his left arm to hide what he is doing and asks, "Hey, who drawed that one?". Reference was to the calendar. Time :40. *MA* not scorable, since he only printed (DICK).

Trial 9: "Draw another man; this time a better one." "I'm not going to draw any more after this one!" Begins and works rapidly. Hands paper to me, "Finished! I'm not going to draw any more!" Time :57. *MA* 6 yrs., 3 mo.

Trial 10: "Draw another man; this time a better one." "Hey! How many do I have to draw?" "Draw another man; this time a better one." "Cut it out!" He is not smiling any more and he begins to work very rapidly. "I'm going to do bad ones." Hands in paper, "That's no good! No *more!*" Time :30. *MA* 5 yrs., 6 mo.

Trial 11: "Draw another man; this time a better one." "No!" "Won't you draw this one?" "I'm tired. I don't wanna do any more!" "Won't you draw this last one?" "What do I have to do after this?" "Won't you draw this last one?" "All right! Promise it's the last one!" "Won't you draw this last one?" Begins and works rapidly. Hands paper in saying with a smile, "Hey, get my brother; he draws good birds." Time :30. *MA* 6 yrs., 6 mo.

Trial 12: "Draw another man; this time a better one." The subject had already run hurriedly out of the room.

6. *ET, Female, 8 Yrs., 3 Mo., Summer Colony Friend*

Trial 1: "Draw the picture of a man. Make the very best picture that you can." "Of a man?" "Draw the picture of a man. Make the very best picture that you can." She begins to draw, looking up often to see if she is being watched. The forefinger of her left hand goes to her mouth quite often. "Shall I put clothes on him?" "Draw the picture of a man. Make the very best picture that you can." "Yes, but shall I put him wearing clothes?" "Draw the picture of a man. Make the very best picture that you can." She snickers a bit then goes back to drawing clothes on the already completed man. Time 14:20. *MA* 8 yrs., 0 mo.

Trial 2: "Draw another man; this time a better one." Starts to work at once without comment. Her tongue works back and forth in unison with the short quick shading strokes, and she bites the forefinger of her left hand occasionally. Time 8:50. *MA* 8 yrs., 6 mo.

Trial 3: "Draw another man; this time a better one." Smiles and begins immediately. The pencil pressure is so great that her whole arm shakes as she draws After completing the drawing, she erases the face and right arm and draws them over again. "Finished." Time 6:30. *MA* 8 yrs., 3 mo.

Trial 4: "Draw another man; this time a better one." Starts at once. Tongue and lips are working incessantly, and her drawing arm and hand tremble noticeably. Time 3:15. *MA* 7 yrs., 3 mo.

Trial 5: "Draw another man; this time a better one." Starts at once. Puffs cheeks and expels breath noisily. Looks up to see if she is being watched. Time 3:45. *MA* 7 yrs., 9 mo.

Trial 6: "Draw another man; this time a better one." Starts at once. Looks up, erases everything and begins again. Time 2:40. *MA* 8 yrs., 0 mo.

Trial 7: "Draw another man; this time a better one." Starts at once. Her lips and tongue work constantly. Throughout she rubs the fingers of her left hand against her thumb, as though to brush off something, or she bites her left forefinger. Time 3:20. *MA* 9 yrs., 0 mo.

Trial 8: "Draw another man; this time a better one." Starts at once. Her left hand is bitten continually, and she sucks in her lower lip and wets it with her tongue. Time 3:30. *MA* 7 yrs., 9 mo.

At this point the experimenters decided to terminate the trials because

they were certain the child would break down shortly and they would not be in a position to handle such a situation. The senior author, a close friend of the child's family, was serving as recorder on this day; he took the child to the summer colony's soda fountain to "rehabilitate" her. During this two-block walk *ET* was trembling and could not answer simple questions. He held her hand and found that she relied upon this for support. Normally *ET* was fluent in conversation and had often been to the soda fountain with the experimenter. This time she did not order and did not reply when the experimenter made suggestions. She gradually regained her composure and after about 20 minutes the experimenter felt that he could return the child to her cottage. It was unfortunate that physiological examination was not possible. Even a record of the clamping of the child's hand on the pencil and the pressure on the paper would have been desirable. The girl was obviously afraid.

References

1. Barker, R. The effect of frustration on cognitive abilities. *Char. & Per.*, 1938, **7**, 145-150
2. Curtis, Q. Some psychological consequences of frustration. *Char. & Per.*, 1938, **7**, 140-145.
3. Dollard, J., Doob, L., Miller, N., Nowrer, O., & Sears, R. Frustration and Aggression New Haven: Yale Univ. Press, 1939. Pp. 209.
4. Goodenough, F. Measurement of Intelligence by Drawings. New York: World Book, 1926. Pp 177.
5. Hartshorne, H., & May, M. Studies in Deceit. New York: Macmillan, 1928. Pp. 306.
6. Haslerud, G. Some interrelations of behavioral measures of frustration. *Char. & Per.*, 1938, **7**, 136-139.
7. Karsten, A. Psychische sättigung *Psychol Forsch.*, 1928, **10**, 142-254.
8. Lewin, K. A Dynamic Theory of Personality. New York: McGraw-Hill, 1935. Pp. 286.
9. Morgan, J. J. B. Keeping a Sound Mind. New York: Macmillan, 1935 Pp. 440.
10. Mowrer, O. H. Anxiety-reduction and learning. *J. Exper. Psychol.*, 1940, **27**, 497-516.
11. ———. A stimulus-response analysis of anxiety and its rôle as a reinforcing agent. *Psychol. Rev.*, 1939, **46**, 553-565.
12. ———. Some research implications of the frustration concept as related to social and educational problems *Char. & Per.*, 1938, **7**, 129-135.
13. Rosenzweig, S. A general outline of frustration. *Char. & Per.*, 1938, **7**, 151-160.

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THE RELATIONSHIP OF SCHOOL MARKS TO THE AMOUNT OF ILLNESS*[1]

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A. THE SETTING AND PURPOSE OF THE STUDY

The present study represents an attempt to determine the effect of the incidence of illness upon the academic success of school pupils. This investigation deals with matched groups selected from the pupils of the Nolan Intermediate School, Detroit, Michigan.

B. THE PROCEDURE

The method of approach in this investigation was that of matched pairs. From the pupils of the Nolan Intermediate School 200 were selected, 60 of whom have been completely free from the 25 illnesses listed in Table 2. These pupils are hereafter referred to as Group I, Section *A*. The remaining 140 have a history of having had one of the 25 illnesses and are referred to as Group I, Section *B*. The members of Group I, Section *A*, were matched with pupils having a history of four or more illnesses and these are hereafter referred to as Group II, Section *A*; while the ones included in Group I, Section *B* were matched with pupils having a history of five or more illnesses. These pupils are hereafter referred to as Group II, Section *B*.

Data relating to the illnesses of Group I, Section *B*, are presented in Table 1. The amount of illnesses in Group II is revealed in Table 2.

Each of the 200 pupils in Group I was paired with one in Group II, whose mental rating, sex, grade, curriculum, and age corresponded.

Pupils of the Nolan Intermediate School choose one of three

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[1]This paper is a summary of a Master's thesis written at the University of Detroit by Pauline E. Conway, *The Relationship of School Marks to the Amount of Illness*. Detroit, Michigan: University of Detroit, June, 1941. Pp. 37.

TABLE 1

THE NUMBER AND PER CENT OF CASES OF ILLNESS IN GROUP I

Illness	Group I-*B* No.	%
Bronchitis	1	.7
Chickenpox	22	15.7
Diphtheria	2	1.4
Influenza	5	3 6
Mastoiditis	1	.7
Measles	70	50.0
Mumps	12	8 6
Pneumonia	3	2.1
Scarlet Fever	8	5.7
Smallpox	1	.7
Tonsilitis	3	2.1
Whooping Cough	12	8.6
Total	140	100.0

TABLE 2

THE NUMBER AND PER CENT OF CASES OF ILLNESS IN GROUP II*

	Group II-*A*		Group II-*B*		Total	
	No.	%	No.	%	No.	%
Asthma	0	0.0	1	.7	1	.5
Bronchitis	0	0.0	1	.7	1	.5
Cardiac	1	1.7	2	1.4	3	1.5
Chickenpox	50	83.3	120	85.7	170	85.0
Chorea minor	1	1.7	0	0.0	1	.5
Diphtheria	2	3.3	19	13.6	21	10.5
Impetigo	0	0.0	1	.7	1	.5
Influenza	16	26.7	55	39.3	71	35.5
Mastoiditis	3	5.0	2	1.4	5	2.5
Measles	59	98.3	138	98.6	197	98 5
Mumps	50	83.3	113	80 7	163	81.5
Nephritis	1	1.7	0	0.0	1	.5
Pneumonia	15	25.0	40	28.6	55	27.5
Poliomyelitis	0	0.0	1	.7	1	.5
Pleurisy	1	1.7	3	2.1	4	2.0
Rheumatism	1	1.7	0	0.0	1	.5
Scarlatina	0	0 0	2	1.4	2	1.0
Scarlet Fever	19	31.7	82	58.6	101	50.5
Septicemia	0	0.0	2	1.4	2	1.0
Sinusitis	0	0.0	1	.7	1	.5
Smallpox	19	31.7	62	44.3	81	40.5
Spinal Meningitis	0	0.0	1	.7	1	.5
Tonsilitis	15	25.0	18	12 9	33	16.5
Tuberculosis	0	0.0	2	1.4	2	1.0
Whooping Cough	52	86.7	124	88.6	176	88.0
Total	305		790		1,095	

*The percentages for Group II-*A* are based upon 60 cases; Group II-*B*, 140; and the total, 200.

TABLE 3
THE MENTAL RATINGS OF THE PAIRS OF PUPILS

Mental rating	Intelligence quotient equivalents	Section A No. of pairs	Section A Per cent	Section B No. of pairs	Section B Per cent	Total No. of pairs	Total Per cent
A	118 and above	7	11.67	12	8.57	19	9.50
B	111-117	11	18.33	16	11.43	27	13.50
C	90-110	37	61.67	103	73.57	140	70.00
D	83- 89	3	5.00	9	6.43	12	6.00
E	82 and below	2	3.33	0	0.00	2	1.00
Total		60	100.00	140	100.00	200	100.00

courses: Commercial, General Language, or Practical Arts. This classification by curricula begins in the ninth grade. Among the 66 ninth grade pupils included in this study, 35 were enrolled in the Commercial Course, 10 in General Language, and 21 in Practical Arts. The pairs were matched perfectly according to the curricula in which they were enrolled.

Table 4 reveals the distribution of pairs according to grade location.

TABLE 4
THE GRADE LOCATION OF THE PAIRS OF PUPILS

Grade location	Section A No. of pairs	Section A Per cent	Section B No. of pairs	Section B Per cent	Total No. of pairs	Total Per cent
7	26	43.33	41	29.29	67	33.50
8	18	30.00	49	35.00	67	33.50
9	16	26.67	50	35.71	66	33.00
Total	60	100.00	140	100.00	200	100.00

tion. The pairs were evenly divided on the basis of sex, there being 100 boy pairs and 100 girl pairs. Table 5 contains information pertaining to sex.

TABLE 5
THE SEX OF THE PAIRS OF PUPILS

Sex	Section A No. of pairs	Section A Per cent	Section B No of pairs	Section B Per cent	Total No. of pairs	Total Per cent
Male	4	66.67	60	42.86	100	50.00
Female	20	33.33	80	57.14	100	50.00
Total	60	100.00	140	100.00	200	100.00

TABLE 6
A COMPARISON OF THE GROUPS

Variables	Group I Mean	Group I SD	Group I σ_M	Group II Mean	Group II SD	Group II σ_M	Differences between means	Pearson r's	σ_D	D/σ_D	Chances in 100 of a true difference greater than zero
Chronological Age											
Section A	166.15	12.10	1 56	166 25	12 60	1.63	.10	.86±.02	0.85	0.12	55
Section B	167.35	11.75	.99	167.70	11 75	.99	.35	.90±.01	0.44	0.80	79
Total	167.00	11.85	84	167.25	12.00	.85	.25	.89±.01	0.40	0.63	74
Absence											
Section A	4 84	4.26	.55	4.50	4.26	.55	.34	.03±.09	.77	.44	67
Section B	4.72	4.20	.35	5.36	4.62	.39	.64	.08±.06	.50	1.28	90
Total	4.74	4.22	.30	5.10	4.52	.32	.36	.07±.05	.42	.86	81
Tardiness											
Section A	1.57	2.21	.29	1.27	1.36	.18	.30	.03±.09	.34	.88	81
Section B	1.17	1.26	.11	1.38	1.66	.14	.21	.09±.06	.17	1.24	89
Total	1.29	1.62	.11	1.34	1.57	.11	.05	.06± 05	.15	.33	63
English											
Section A	1 38	.97	.13	1.34	.64	.08	.04	.15±.09	.14	.29	61
Section B	1.56	.66	.06	1.53	.71	.06	.03	.22±.05	.07	43	67
Total	1.51	.77	.05	1.47	.70	.05	.04	.22±.05	.06	.67	75
General Science											
Section A	1.42	.75	.10	1.40	.75	.10	.02	.46±.07	.10	.20	58
Section B	1.48	.71	.06	1.50	.66	.06	.02	.33±.05	.07	.29	61
Total	1 46	.72	.05	1.47	.69	05	.01	.37±.04	06	.17	57
Health											
Section A	2.26	.63	.08	2.10	.64	08	16	.05±.09	.11	1.45	93
Section B	2.35	56	.05	2.38	.53	.04	.03	.04±.06	.06	50	69
Total	2.32	.58	.04	2.29	.58	.04	.03	06±.05	.05	60	73
Mathematics											
Section A	1.36	.92	.12	1.27	.60	.08	.09	.17±.08	.13	.69	75
Section B	1.51	.72	.06	1.40	.71	.06	.11	.35±.05	.07	1.57	94
Total	1.47	.79	.06	1.36	.68	.05	.11	.30± 04	.07	1.57	94
Social Science											
Section A	1.55	.93	.12	1.72	.71	.09	.17	.12±.09	.14	1.21	89
Section B	1.75	.73	.06	1.73	.73	.06	.02	.25±.05	.07	.29	61
Total	1.69	.75	.05	1.73	.72	.05	.04	.22±.05	.06	.67	75
All Subjects											
Section A	1 52	.65	.08	1.49	.47	.06	.03	.31±.08	.08	.38	65
Section B	1 65	.52	.04	1.64	.52	.04	.01	.32±.05	.04	.25	60
Total	1 61	.56	.04	1 59	.51	.04	.02	.32±.04	.04	.50	69

The pupils were matched according to chronological age expressed in months as of June 1, 1940. A detailed comparison of the chronological ages for Sections *A* and *B* as well as for the total groups is contained in Table 6. A review of Table 6 reveals the carefulness of the matching of the groups on the basis of age.

Some additional data were obtained for all pupils. Even though these data were not used as bases for matching, it is interesting to compare the groups on these variables. The average number of times absent per semester and the average number of times tardy per semester was calculated for each pupil. The comparisons are included in Table 6. The group differences are not statistically significant.

C. The Method of Measuring Achievement

Scholastic achievement in this investigation was measured by calculating honor point averages based on teachers' marks. Marks for the subjects common to all the curricula, namely, English, general science, health, mathematics, and social science were obtained. The marking system used is a letter rating of *A*, *B*, *C*, *D*, and *E*. *A* means superior; *B*, above average; *C*, average; *D*, below average; and *E*, failure. In order to determine honor point averages, a mark of *A* was given three honor points; *B*, two; *C*, one; *D*, none; and *E*, a minus one. The letter grades in terms of honor points were multiplied by the appropriate number of credit hours, thus giving the total number of honor points. The total number of honor points for each subject was divided by the number of credit hours, the result being the honor point average. The total honor point average was found for all subjects combined by using the same method.

D. The Comparative Scholastic Achievement of the Groups

The comparisons based upon honor point averages are included in Table 6. Group I as a whole, as well as separately for Sections *A* and *B*, was compared with Group II. There were 18 comparisons of Group I with Group II pupils. In 13 of the comparisons, the Group I pupils had a higher mean honor point average; in five of the comparisons, the Group II pupils had a higher mean honor point average. Not one of the comparisons revealed a statistically significant difference between means based upon the honor point averages.

E. Summary and Conclusions

This study has attempted to answer the question: *What is the effect of illness on academic achievement.* Two hundred pupils "with a history of illness" were matched with 200 "without a history of illness" according to intelligence, chronological age, sex, grade, and curricula. An honor point average based upon teacher's marks was computed for each of the 400 pupils in English, general science, health, mathematics, social science, and all subjects combined. Eighteen comparisons involving honor point averages were made. All of the differences found are so small that they may be due to the errors of random sampling. This study does not show a decrease in school achievement due to illnesses. It is entirely possible that illness has a temporary effect tending to decrease academic success. The data at hand fail to reveal any permanent detrimental effects on school success due to illness of the types considered in this study.

The groups were also compared on the amount of absence and tardiness. The differences were not statistically significant.

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THE EFFECT OF CHRONOLOGICAL AGE ON REVISED STANFORD-BINET VOCABULARY SCORE AT THE MORON AND IMBECILE LEVELS*

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Basing their decision on a wide variety of evidence, Terman and Merrill (7, p. 302) have included a vocabulary test in their 1937 Revision of the Stanford-Binet. From a statistical viewpoint, this test, which measures a child's ability to define orally a selected list of words, appears to be one of the most valuable in the entire battery. Not only do vocabulary scores, according to the authors, show definite increments from age to age, but they also correlate very highly with mental age rating on the test as a whole. In some cases, these correlations are as high as +.91 for separate one year age groups, with the mean coefficient at +.81. For the group on which Terman and Merrill have standardized their battery, these data are probably good evidence to show that score on the vocabulary test can largely be explained by the total mental age score on the rest of the battery; and that other factors such as previous vocabulary training and different school situations are of relatively small importance.

While this may be an adequate conclusion to draw from the scores made by the standardization group, yet it may not be at all applicable to certain selected and atypical groups of subjects. For example, it is reasonable to suppose that 17-year-old morons with a mental age of eight may make a higher mean score on the vocabulary test than will normal eight-year-old children. Since most of the first 16 words on the test are in very common use by older children and adolescents, it may be that mentally retarded adolescents learn these words through constant daily contact with them over a period of years. Again, certain words such as "scorch," "lecture," or "brunette" may have a greater interest value for adolescents than for seven- or eight-year-old children. Because of these considerations it

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is important to know the exact influence that chronological age has on the vocabulary ability of a homogeneous group of mental defectives. If mental age is rendered constant from one age group to another, will other factors such as chronological age still remain in sizeable quantity to help explain score on the vocabulary test?

Method and Results of the Experiment

In planning this experiment, due cognizance was taken of other investigations which have been conducted in this field. Of the four studies which have been directly concerned with this problem, only Louden (4) applied rigid experimental controls. Taking her cases from the files of the University of Pittsburgh psychological clinic, she paired each member of a bright group of subjects (Mean $IQ =$ 121.0) with a subject from a dull group (Mean $IQ = 61.0$) in regard to sex and mental age. By mental age was meant the total score on the remaining battery of the 1916 Stanford-Binet Tests after the influence of the vocabulary test had been removed. In contrast to Louden's matching procedure, Terman (6), Wallin (8), and McFadden (5) first separated their total number of subjects into various mental age sections and divided each section into a dull and normal group. Mean Stanford Vocabulary scores were then calculated for each group and the resulting differences between the dull and normal groups were tested for significant differences.

While the application of experimental controls may be a suitable procedure to employ in this type of experiment, it involves many difficulties. Matching a group of young retarded children with a group of older feebleminded adolescents in respect to two or three variables means that many cases in either group will have to be discarded. This may involve the loss of much valuable data. Then too, if many subjects are discarded because they fail to match others in regard to sex or mental age, the assumption of random sampling may not be satisfied. For these reasons the writer decided to employ statistical controls instead of the usual experimental ones in treating the data of this research.

With this plan in mind, the writer first eliminated from the imbecile and moron population at the Minnesota School and Colony all subjects between the ages of 10-6 and 17-5 who had serious speech, sensory, physical, or reading difficulties and all who were

classified by the institution physicians as "clinical types." To the remaining group of 202 subjects the writer then administered, within a period of six months, the Revised Stanford-Binet Intelligence Test, Form *L*. Each blank was first scored by the writer and then rescored and checked by an assistant. When this was completed, the total group was divided into seven different chronological age groups (Table 1). The writer then proposed the hypothesis that vocabulary

TABLE 1

MENTAL AGE AND REVISED STANFORD-BINET VOCABULARY DATA FOR 202 INSTITUTIONAL SUBJECTS WITH THE *CA* RANGE FROM 10-6 TO 17-5 *IQ* RANGE FROM 38 TO 87; AND *MA* RANGE FROM 4-10 TO 13-1*

CA group	(1) 10-6 to 11-5	(2) 11-6 to 12-5	(3) 12-6 to 13-5	(4) 13-6 to 14-5	(5) 14-6 to 15-5	(6) 15-6 to 16-5	(7) 16-6 to 17-5	10-6 to 17-5
Number of cases	14	19	19	34	32	40	44	202
Mean *MA* (*X*) (in mos.)	86.07	85.21	90.95	99.53	104.41	114.95	117.20	104.12
Sigma** of the *MA*'s	14.69	12.91	16.37	16.42	16.55	16.60	15.91	21.33
Mean vocabulary score (*Y*)	6 93	7.11	8.37	8 85	10.31	11.05	11.91	9.84

*For the total group of 202 subjects the Mean *CA* = 173.38; Mean *IQ* = 62.36; σ_{IQ} = 10.32; Vocabulary range = 2 to 19; $\sigma_{Vocab.}$ = 2.95. Fifty-nine cases earned *IQ*'s between 70 and 87.

**Since the *F* ratio between the variances for Group 2 and 6 is 1.65, the *P* is not significant at the .01 level. The variances of all other groups are smaller than Group 6 and larger than Group 2. Therefore the *F* ratio between any other two variances is insignificant and less than .01.

differences from one group to the other would prove to be insignificant if the variable of mental age[1] were held constant for all chronological age groups. In order to test this hypothesis on our total sample, it was necessary to conduct an analysis of covariance. Before doing this, however, we made sure that the variances between any two of our seven groups were insignificant.[2] According to Table

[1]In this paper "mental age" is the rating which every subject received on the Revised Stanford-Binet after the influence of the vocabulary test had been subtracted.

[2]This is the assumption of homogeneity of variance between groups which must be satisfied before an analysis of covariance can be conducted.

1, the F ratio in every comparison between any two CA groups, falls below the one per cent level of significance. Since the total regression between mental age and vocabulary score was linear and since we tested the entire population at the institution between certain age ranges, an analysis of covariance was justifiable.

Employing the statistical techniques first discovered by Fisher (1) and very recently detailed by Lindquist (3, p. 191), we analyzed our data into two separate variances, within groups and between groups, for three categories: (a) X = mental ages; (b) Y = vocabulary and (c) adjusted Y (Table 2). Following this, we calculated

TABLE 2
THE VARIANCE OF REVISED STANFORD-BINET VOCABULARY SCORES (Y) BETWEEN AND WITHIN CA GROUPS WHEN ADJUSTED MENTAL AGES (X) ARE RENDERED CONSTANT*

	Unadjusted values					Adjusted values		
Variation	DF**	X^2	Y^2	Variance Y	XY	DF**	Y^2	Variance Y
Between CA groups	6	27,562.93	592.06	98.68	3,996.10	6	65.51	10.92
Within CA groups	195	63,863.23	1,158.02	5.94	5,914.02	194	610 36	3.15
Totals	201	91,426.16	1,750.08		9,910.12	200	675.87	

*Adjusted Mental age on Revised Stanford-Binet, Form L = Total mental age rating minus the mental age score earned on the vocabulary test
**Degrees of freedom.

the F ratio between the unadjusted Y variances. This value, F = 16.61 is significant at the one per cent level. Since the Pearson coefficient of correlation between the X and Y variables for our entire group proved to be +.78, it was necessary to render constant mental age ratings before we could study the fundamental influence of chronological age on vocabulary score.[3] Consequently, by employing the obtained values for X^2 and XY, we adjusted the preliminary values of Y^2 and then calculated the reduced variances for Y. When we computed the new F ratio between these variances, we found that

[3]It would have been inappropriate to employ the technique of partial correlation for two main reasons: (a) the distribution of chronological ages for our group is decidedly skewed to the right. (b) Only an F ratio between adjusted Y variances could have given us a measure of the significant influence of chronological age on vocabulary score.

$F = 3.47$. According to the Snedecor tables (3, p. 62) this ratio is significant at the one per cent level. By reason of this result we can conclude that our original hypothesis has been proven false; and that chronological age must be considered an important and significant factor in explaining vocabulary score within the limitations set by our sample.

Previous to this experiment, Wallin (8) and McFadden (5), using the method of experimental control, came to similar conclusions. As part of his research, McFadden compared young and old feebleminded subjects in four separate mental age groups from six through nine. After administering the 1916 Stanford-Binet Vocabulary Test to these subjects, he found that within every mental age group the older feebleminded made higher mean scores than the younger and that within the seven-, eight-, and nine-year groups the older made significantly higher scores than the younger, i.e., critical ratios of 3.00 and above. As a result of their research, both Terman (6) and Louden (4) came to different conclusions than McFadden. In his 1918 study Terman, after comparing 112 subnormal children below the *IQ* of 86 with 150 children between the *IQ*'s of 86 and 114, could find no marked differences in vocabulary score between the two groups. Louden, however, after matching bright children with mentally defective subjects in respect to mental age and sex, found all differences to be in favor of the bright, and in one case, the mental age of seven, significantly so.

Discussion and Summary

Without doubt, mental age rating on the Revised Stanford-Binet (when the influence of the vocabulary test has been eliminated) and chronological age are not the only factors which can explain score on the vocabulary test. It may well be that such variables as socio-economic status, reading experiences, or previous training in vocabulary can influence final score on such a test. In the present sample, however, 86.8 per cent of the mentally retarded subjects could definitely be classified in socio-economic Group VI or VII according to the Goodenough-Minnesota Scale (2); and only 1.6 per cent in Group III. Since no subject of our group had ever been tested with the Revised Stanford-Binet previous to the examinations reported in this paper, the variable of previous practice could also be

discounted. These considerations, then, would tend to support the hypothesis that mental age rating and chronological age are the two major variables which can almost entirely explain score on the Revised Stanford-Binet Vocabulary Test as far as the limits set by our sample.

After eliminating all subjects between the ages of 10-6 and 17-5 at the Minnesota School and Colony who had serious speech, sensory, physical, or reading disabilities, the writer administered Form *L* of the Revised Stanford-Binet to the remaining 216 cases. Following this we proposed the hypothesis that differences in score on the vocabulary test from one chronological age group to another could be almost entirely explained by the adjusted mental age rating (total mental age rating minus the mental age rating earned on the vocabulary test) which the subjects received on the Revised Stanford-Binet. In order to test this hypothesis, we employed Fisher's techniques of covaiiance analysis. When we rendered the variable of mental age constant from *CA* group to *CA* group, we found that the groups still diffeied significantly in vocabulary score. Because of this, we concluded that the factor of chronological age must, along with the mental age variable, be considered important in the explanation of score on the Revised Stanford-Binet Vocabulary Test.

REFERENCES

1. FISHER, R. A. Statistical Methods for Research Workers. London: Oliver & Boyd, 1936.
2. GOODENOUGH, F. L., & ANDERSON, J. E. Experimental Child Psychology. New York: Century, 1931. (Appendix *A*)
3. LINDQUIST, E. F. Statistical Analysis in Educational Reseaich New York: Houghton Mifflin, 1940.
4. LOUDEN, M. V. Relative difficulty of Stanfoid-Binet Vocabulary for bright and dull subjects of the same mental level. *J. Educ. Res.*, 1933, **27**, 179-186.
5. MCFADDEN, J. H. Differential responses of normal and feebleminded subjects of equal mental age, on the Kent-Rosanoff Free Association Test and the Stanford Revision of the Binet-Simon Intelligence Test. *Ment. Meas. Monog.*, 1931, No. 7. Pp. 85.
6. TERMAN, L. M. The Vocabulary Test as a Measure of Intelligence. *J. Educ. Psychol.*, 1918, **9**, 452-466.
7. TERMAN, L. M., & MERRILL, M. A. Measuring Intelligence. Boston: Houghton Mifflin, 1937.

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THE EFFECTS OF AVITAMINOSIS-A ON VISUAL DISCRIMINATION IN THE RAT: GROSS EFFECTS ON COLOR DISCRIMINATION*

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A. INTRODUCTION

The establishment of the importance of vitamin *A* as the precursor and the product of the visual purple system through studies of the bio-chemistry of vision and of vitamin *A*-deficiency in man and animals has led to the development of an hypothesis from which implications of considerable import to the problem of visual sensation may be drawn. The present study is concerned with the experimental test of one of these implications.

It has been demonstrated that vitamin *A*-deficiency in man (Wald, Jeghers and Arminio, 1938; Hecht and Mandelbaum, 1938; Haig, Hecht, and Patek, 1938) and in the rat (Holm, 1925; Morgan, 1938) causes an increase in brightness thresholds. This relationship appears to hold because of the fact (Wald, 1935-36) that the amount of vitamin *A* resulting from the thermal reactions of retinene is not sufficient to keep the visual purple system closed. The latter system, therefore, is dependent upon the diet for its replacement, this being accomplished through the blood circulation.

Wald (1937), Wald and Zussman (1937), and Chase (1938) have presented biochemical evidence for the existence of a separate cone pigment (visual violet) in animals. However, Wald, Jeghers, and Arminio (1938), Hecht and Mandelbaum (1938), and Haig, Hecht, and Patek (1938) have conducted researches with human subjects which indicate, from a functional point of view, that both the rod and cone pigments are affected by deficiencies in vitamin *A* but to a different degree. The latter studies were concerned with brightness vision and involved changes in final rod and cone thresh-

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olds and, in cases of cirrhosis of the liver, the cone-rod transition time. The most striking aspect of these changes was the fidelity with which the cone thresholds varied with the rod thresholds in response to alterations in vitamin *A* concentration. It is logical to conclude, then, that vitamin *A* has a chemical relation to visual violet resembling the one it has to visual purple.

This converging evidence leads to the prediction which the present study attempts to test, namely, if, in the anatomical unit, the cone, there is only one biochemical system activated by photic stimulation and this system is affected in brightness vision by a deficiency of vitamin *A*, a similar effect should be evident in color vision, a function attributable to cone vision alone.

This prediction may be tested most conveniently by two experimental approaches. The first approach would be through an experimental study of the effects of avitaminosis-*A* on color vision where the hues are kept constant and any gross effects of the deficiency observed. The second approach would be to determine the effects of vitamin *A*-deficiency on hue thresholds at various points in the visible spectrum. The present report is limited to the first approach, although plans have been developed to complete the study by observations on hue thresholds as well.

B. Technique

The apparatus used in these experiments has been described in detail by Walton and Bornemeier (1939). Certain devices, designed to speed up the experiment by decreasing the time required for shifting the filters and adjusting the brightness controls, have been added. These include: (*a*) A lever and cable assembly attached to the filter slide which acts as a remote control at the operator's seat; (*b*) a foot switch, which, by means of an electro-magnet, operates a master reversing switch; and, (*c*) a remote control lever which adjusts the distance of the lights from the filters and is manipulated from the operator's seat. Another device, designed to speed up the experiment, is an electrically charged surface which replaces the jumping platform and is controlled from the experimenter's seat.

In addition, another change has been made to facilitate better coördination between the operator and the experimenter during the trial runs. Signalling lights have been installed which will flash on a

control panel *only* when the apparatus has been correctly set for each trial. This involves switches which are closed when: (*a*) The hinged bottoms of the color-chambers are properly locked; (*b*) the intensity control is properly set; (*c*) the master reversing-switch has been thrown; and, (*d*) the slides have been properly changed. A complete two-way set of lights has been installed for use by the operator and experimenter in signalling to each other that: (*a*) The apparatus is set for the next trial; and, (*b*) the animal is either in the food compartment or has been removed from the apparatus.

All these devices simply speed up the experimental trials so that 150 trials may be run every 30 minutes and insure the complete elimination of error in operation.

Discrimination was established between Wratten "Alpha 70" (dark red) and Wratten "Eta 75" (blue), half of the animals being trained to the red and half to the blue. The training procedure has been described in detail by Walton and Bornemeier (1939). The rats were required to make their choice after having been placed on the jumping platform. As a check on possible cues due to the placement of the animal on the platform different experimenters were used from time to time and different methods of placement were employed throughout the experiment.

The animals were run 30 trials each day except for the first few days of the experiment when they were given only 15 trials because of their initial reactions to "falling through" the doors of the color chambers when making an incorrect choice. The 30 trials per day were continued until the animal died. In all approximately 14,000 trials were run with the 18 animals.

The red and blue filters were changed in a random order and the slide containing the filters was moved in such a way as to eliminate any possibility of differential cues due to the noise of the apparatus itself. This noise factor was checked by an experimenter who wrote down his judgments of the order of color presentation on the basis of movements of the apparatus. The results were negative. It should also be pointed out that the time relations between the changing of the apparatus and the choice by the animal were usually considerably longer than the period for success in delayed reaction experiments with rats. In addition, the orientation of the animal toward the apparatus was being changed during this period by the experimenter.

Control of the intensity factor, which is of such great significance in studies of hue discrimination, was accomplished by maintaining the intensities of the two colors at the "point of subjective equality" (*P.S.E.*) determined by Walton and Bornemeier (1939) for the rat's eye with the particular filters used in the present experiment. As a further check after the hue discrimination habit had been established the intensities of the two colors were changed from trial to trial in a random order but in an order different from that of the changing hues. Under these conditions the animals in every case persisted in their established pattern of hue discrimination without exhibiting any effect of the intensity changes, unless the latter were so great that the animal became light adapted to the point where it could not orient to the apparatus in order to make a discrimination.

On completion of a successful choice the animal was rewarded with a small pellet of vitamin *A*-deficient diet. When an incorrect choice was made the floor of the color chamber was released and the animal fell through into a net below.

When the animals were not being run on the apparatus they were kept in an animal room isolated in pairs from the rest of the colony. The animals were exposed to the light most of the day and were dark-adapted just preceding their trials on the apparatus. As soon as the experimental period was over the rats were returned to the animal room and fed a small amount of vitamin *A*-free diet. The animals were carefully weighed each day and their weights plotted on a chart as an index of their general physical condition.

C. Animals

The 18 subjects were albino and hooded rats obtained from a colony of inbred animals at the University of Nebraska Agricultural College. The animals were taken as soon as they were old enough to be weaned and placed on a vitamin *A*-free diet. The mothers had been on a diet in which butter was the only source of vitamin *A* from a period preceding fertilization. . This was necessary because of the fact that when litters from females on normal diet were used the period for breakdown from vitamin *A*-deficiency was tremendously increased due to the storage of vitamin *A* in the bodies of young animals.

The vitamin *A*-free diet was obtained from the Experimental

Laboratories of the Agricultural College[2] and had been tested over a period of several years. Results of feeding on such a diet are available for hundreds of animals studied in these laboratories and are similar to changes observed in our animals. Conditions of xerophthalmia developed first, accompanied or slightly preceded by losses in the normal rate of body weight increase. These eye conditions tended to clear up in many of the animals just preceding their deaths. With continued feeding on vitamin *A*-free diet and following the appearance of xerophthalmia the animals exhibited a lack of normal motor coördination to varying degrees. In a majority of animals this poor coördination was apparent particularly in the hindquarters. In spite of such difficulties the animals persisted, with great rapidity in most cases, in making discriminations.

D. Results

Table 1 illustrates the average number of correct responses per unit of 25 trials for the 18 animals. Units 21 to 30 represent the performance of 10 animals who continued to live on the vitamin *A*-free diet for that additional period.

The high initial proficiency of the animals as indicated by these figures is understandable in terms of the training technique. When an animal made a mistake and "fell through" the apparatus during the initial trials it was necessary to force it to make the next choice. Under these conditions the animal was forced always to jump to the correct stimulus. This increased the number of correct responses occurring during the beginning of each animal's training period and accounts for the high original proficiency as a function of the procedure employed.

The significant point illustrated by Table 1 is the fact that the proficiency of discrimination did *not* decrease with increasing deficiency of vitamin *A*. The animals were able to discriminate accurately up to the very day in which they died of the effects of avitaminosis-*A*. In the case of several animals who lived through 900 trials the high proficiency of the discriminative behavior had still not diminished.

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[2]The authors wish to acknowledge the assistance of Mr. I. L. Hathaway of the Experimental Laboratories, University of Nebraska Agricultural College, in the rearing of the animals under conditions of avitaminosis-*A* and in obtaining a vitamin *A*-free diet of tested quality.

TABLE 1
AVERAGE PER CENT OF CORRECT RESPONSES IN UNITS OF 25 TRIALS FOR THE 18 ANIMALS

Unit of 25 trials	Average per cent correct
1	78
2	75
3	83
4	82
5	83
6	86
7	88
8	94
9	93
10	92
11	94
12	97
13	98
14	97
15	96
16	97
17	95
18	98
19	98
20	98
21	95
22	95
23	96
24	96
25	97
26	99
27	96
28	96
29	99
30	98

E. SUMMARY AND CONCLUSIONS

Eighteen albino and hooded rats were given approximately 14,000 trials on a discrimination apparatus devised to present two colors of constant wave-length at intensities equated for the animals' eyes. Checks were made in order to insure the isolation and control of the variables by the experimenters. The independent variable was an increasing deficiency of vitamin *A* from the time of each animal's birth until its death from that cause. A search was made for any concomitant variations occurring in the animal's behavior on the discrimination apparatus. None were noted even up to the day of the animal's death.

These observations lead to the conclusion that a marked decrease

in the vitamin *A* supply available through the blood circulation to supplement the amount of vitamin *A* resulting from the thermal reactions of the retinene in the visual cycle does not effect the gross color discrimination of the depleted rat. This does not imply that if the animal could be kept alive indefinitely on a vitamin *A*-free diet it would not eventually be affected even in its gross discriminations of color.

The next step in testing the prediction which the present research was devised to study in part is to observe the effects of avitaminosis-*A* on hue thresholds. This proposed study will be analogous to the researches on brightness thresholds which have added such weight to the original hypothesis concerning the importance of vitamin *A* to the visual cycle.

References

1. Chase, A. M. Photosensitive pigments from the retina of the frog. *Science*, 1938, **87**, 238.
2. Haig, C., Hecht, S., & Patek, A. J. Vitamin *A* and rod-cone dark adaptation in cirrhosis of the liver. *Science*, 1938, **87**, 534-536.
3. Hecht, S., & Mandelbaum, J. Rod-cone dark adaptation and vitamin *A*. *Science*, 1938, **88**, 219-221.
4. Holm, E. Demonstration of hemeralopia in rats nourished on food devoid of fat-soluble *A*-vitamin. *Amer. J. Physiol.*, 1925, **73**, 79.
5. Morgan, C. T. The dark-adaptation curve of normal rats and rats deprived of vitamin *A*. *Psychol. Bull.*, 1938, **35**, 718-719. (And personal communication.)
6. Wald, G. Carotinoids and the visual cycle. *J. Gen. Physiol.*, 1935-36, **19**, 351-371.
7. ———. Photo-labile pigments of the chicken retina. *Nature*, 1937, **140**, 545.
8. Wald, G., & Clark, A. B. Sensory adaptation and chemistry of retinal rods. *J. Gen. Physiol.*, 1937-38, **21**, 93-105.
9. Wald, G., Jeghers, H., & Arminio, J. An experiment in human dietary night blindness. *Amer. J. Physiol.*, 1938, **123**, 723-746.
10. Wald, G., & Zussman, H. Carotinoids of the chicken retina. *Nature*, 1937, **140**, 197.
11. Walton, W. E., & Bornemeier, R. W. Color discrimination in rats. *J. Comp. Psychol.*, 1939, **28**, 417-436.

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The Journal of Genetic Psychology, 1942, **61**, 335-346.

BOOKS

The *Journal of Genetic Psychology*, the *Journal of General Psychology*, and the *Journal of Social Psychology*, will buy competent reviews at not less than $2 per printed page and not more than $3 per printed page, but not more than $15.00 for a single review.

Conditions. Only those books that are listed below in this section are eligible for such reviews. In general, any book so listed contains one or more of the following traits: (*a*) Makes an important theoretical contribution; (*b*) consists largely of original experimental research; (*c*) has a creative or revolutionary influence in some special field or the entire field of psychology; (*d*) presents important techniques.

The books are listed approximately in order of receipt, and cover a period of not more than three years. A reviewer must possess the Ph.D. degree or its equal in training and experience.

Procedure. If among the books listed below there is one that seems important to you, you are invited to write a review of that book. It is not necessary to make arrangements with the Editor. Just send in your review. It does not matter if the book in question has been reviewed before.

(1940)

CANTRIL, H. The Invasion from Mars: A Study in the Psychology of Panic. Princeton: Princeton Univ. Press, 1940. Pp. 228.

RASHEVSKY, N. Advances and Applications of Mathematical Biology. Chicago: Univ. Chicago Press, 1940. Pp. 214.

BURLINGAME, L. L. Heredity and Social Problems. New York: McGraw-Hill, 1940. Pp. 369.

DENNIS, W. The Hopi Child. New York: D. Appleton-Century, 1940. Pp. 204.

HILGARD, E. R., & MARQUIS, D. G. Conditioning and Learning. New York: Appleton-Century, 1940. Pp. 429.

HARTMAN, G. W., NEWCOMB, T., *Editors*. Industrial Conflict: A Psychological Interpretation. New York: Cordon, 1940. Pp. 583.

DOOB, L. W. The Plans of Men. New Haven: Yale Univ. Press, 1940. Pp. 411.

HULL, C. L., HOVLAND, C. I., ROSS, R. T., HALL, M., PERKINS, D. T., & FITCH, F. B. Mathematico-Deductive Theory of Rôte Learning. New Haven: Yale Univ. Press, 1940. Pp. 329.

LANDIS, C., *et al.* Sex in Development. New York: Hoeber, 1940. Pp. 329.

THORNDIKE, E. L. Human Nature and the Social Order. New York: Macmillan, 1940. Pp. 1019.

GESELL, A., *et al.* The First Five Years of Life. New York: Harper, 1940. Pp. 393.

YOUNG, K. Personality and Problems of Adjustment. New York: Crofts. Pp. 868.

BROWN, J. F. The Psychodynamics of Abnormal Behavior. New York: McGraw-Hill, 1940. Pp. 484.

GOLDSTEIN, K. Human Nature. Cambridge: Harv. Univ. Press, 1940. Pp. 258.

KATONA, G. Organizing and Memorizing. New York: Columbia Univ. Press, 1940. Pp. 318.

BAKKE, E. W. The Unemployed Worker. New Haven: Yale Univ. Press, 1940. Pp. 465.

(1941)

ZIPF, G. K. National Unity and Disunity. Bloomington, Ind.: Principia Press, 1941. Pp. 408.

REIK, T. Masochism in Modern Man. New York: Farrar & Rinehart, 1941. Pp. 439.

BRITT, S. H. Social Psychology of Modern Life. New York: Farrar & Rinehart, 1941. Pp. 562.

BARTLEY, S. H. Vision: A Study of Its Basis. New York: Van Nostrand, 1941. Pp. 350.

CANTRIL, H. The Psychology of Social Movements. New York: Wiley, 1941. Pp. 274.

MILLER, N. E., & DOLLARD, J. Social Learning and Imitation. New Haven: Yale Univ. Press, 1941. Pp. 341.

DEARBORN, W. F., & ROTHNEY, J. W. M. Predicting the Child's Development. Cambridge: Sci-Art 1941. Pp. 360.

FARAGO, L. (Ed.) German Psychological Warfare. New York: Committee for National Morale, 1941. Pp. 133.

(1942)

SHELDON, W. H. The Varieties of Temperament. New York: Harper, 1942. Pp. 520.

KLOPFER, B., & KELLEY, D. M. The Rorschach Technique. New York: World Book, 1942. Pp. 436.

SCHILDER, P. Goals and Desires of Man. New York: Columbia Univ. Press, 1942. Pp. 305.

MILLER, J. G. Unconsciousness. New York: Wiley, 1942. Pp. 329.

ALLPORT, G. W. The Use of Personal Documents in Psychological Science. New York: Social Science Research Council, 1942. Pp. 210.

BENDER, I. E., IMUS, H. A., ROTHNEY, J. W. M., KEMPLE, C., & ENGLAND, M. R. Motivation and Visual Factors. Hanover, N. H.: Dartmouth College, 1942. Pp. 369.

BORING, E. G. Sensation and Perception in the History of Experimental Psychology. New York: Appleton-Century, 1942. Pp. 644.

GROVES, E. R., GROVES, G. H., & GROVES, C. Sex Fulfillment in Marriage. New York: Emerson, 1942. Pp. 319.

WATSON, G. (*Ed.*) Civilian Morale. New York: Houghton Mifflin, 1942. Pp. 463.

BIBER, B., MURPHY, L. B., WOODCOCK, L. P., & BLACK, I. S Child Life in School. New York: Dutton, 1942. Pp. 644.

HOLLINGWORTH, L. S. Children Above 180 *IQ*. New York: World Book, 1942. Pp. 332.

KLÜVER, H. (*Ed.*). Biological Symposia: Visual Mechanisms. Lancaster: Cattell Press, 1942. Pp. 322.

CRITICAL REVIEWS OF RECENT BOOKS

(Rosett, J. The Mechanism of Thought, Imagery, and Hallucination. New York: Columbia Univ. Press, 1939. Pp. 289.)

REVIEWED BY RALPH W. ERICKSON

Although the late Professor Rosett has been well known for his work on the tracing of tracts through his method of cerebral explosions, this work is probably more ambitious as he attempts to explain a large portion of the phenomena of psychology in neural terms, especially with the help of Hughlings Jackson's Law of Evolution and Dissolution of the Nervous System. According to this law the latest acquired and most complex functions are more affected by an injury or disease and are slower to recover from than the earlier acquired and simpler functions. Rosett modifies the law, however, to account for experiences with anesthetic drugs where thought, imagery, and hallucination endure beyond sensory reception. In situations of this type the depression of sensory reception is supposed actually to initiate the activity of the complex mental functions with a vividness inversely proportional to that of the sensory activity.

To understand the conscious or sensory state the author holds that it is necessary to comprehend the mechanism and significance of the emotions. The physical basis of the latter are the changes that take place in the body as a result of its collision with the surrounding forces. The expression of the emotions are the external manifestations of the bodily changes, and their feelings are certain changes in the nervous system. The bodily changes inform the organism of the environment, while the conscious state owes its existence to the bodily emotions. During emotional activity, the cerebral cortex as the repository of memories plays an important part in telling whether an external disturbance on the body is of importance, with the result that the emotional reaction does not depend upon the size of the disturbance. On the other hand emotional displays may occur to slight stimuli without the aid of a cerebrum as in infants born with large cerebral defects, idiots, and animals whose cortex has been

removed experimentally. This is due to the center of emotional activities being below the cortex, with the latter usually merely determining their kind and intensity in connection with past experience.

In considering the relations of the emotions to the conscious or sensory state, it is first pointed out that sensory impulses may cause reactions without necessarily involving consciousness. The experience of sensation is produced only by some of the nerve impulses that reach the cerebral cortex. These sensations are necessary in order to execute many protective reactions, and involve adaptive processes of learning. On the way to the cerebrum, however, the sensory impulses are relayed in the thalamus where they can influence all the organs of the body by way of the autonomic system and the adrenal medulla. If the thalamus is injured, the subjective experiences are apt to be poorly localized, poorly graded in kind, and yet abnormally intense. The experience is either intensely agreeable or disagreeable, with an immediate and intense response. This is explained as meaning that at the level of the thalamus there is a form of awareness the author calls feeling, which is not evaluated in terms of past experience and accordingly is not graded and is poorly localized. This is due to the fact that there are only about 1,000,000 nerve fibers entering the thalamus but about 10 times that number in the thalamus itself. When the nerve impulses pass from the thalamus to the cerebral cortex there is a possibility of entering into some 12,000,000,000 fibers. Such a great increase allows stimuli to be graded and localized as well as evaluated in the light of past experiences. In this way the feelings of the thalamus become transformed into sensations. These sensations appear to be the same as those of the psychologist, while the feelings evidently are not the technical ones of pleasantness and unpleasantness but rather a mere vague awareness.

After passing through the various association systems of the cortex the nerve impulses can influence the thalamus in the light of past experience by either increasing or decreasing the reactions initiated by the latter. In this way the cortex in a roundabout way but with the modifications based on past experience is able to control the functions of the autonomic system.

The cerebral cortex is not only able to control the emotions by its influence on the thalamus but also controls the skeletal muscles. Volitional acts are those that do not satisfy immediate needs of the

body and are accordingly difficult. Its motive is more or less distant and its genesis always lies in past experience, for past experience leads one to anticipate future benefits. The nerve pathway for carrying voluntary impulses is the pyramidal tract so that these impulses constitute the will. No mention is made of the fact that the pyramidal tract also carries impulses for immediate needs and actions. There is also no discussion of how one set of activities rather than another happen to get control over the motor area, a problem of far greater importance in a discussion of will than the problem of the function of the pyramidal tract which has been solved long ago. Moreover, there is no consideration of extra-pyramidal paths which might be used in recovery from hemiplegia.

After a brief review of the work of Flechsig, Lucas, and Adrian on the nature of the nerve impulse, a brief consideration of aphasia is made in relation to memory on the one hand and to the association systems of the cerebral cortex on the other. From his earlier study on the distribution of nerve fibers in the cerebrum, Rosett accounts for the difference between sensory and motor aphasia as due to injuries in the arcuate nerve system for the former, and injuries in the uncinate and inferior longitudinal nerve systems for the latter. As the arcuate system is gathered into a compact bundle in passing around the end of the fissure of Sylvius, injuries in the angular and supramarginal convolutions can produce a profound aphasia and disorganization of the memories of sensations. Injuries in the lower frontal convolutions, on the other hand, could sever the receptive areas from the motor area and disorganize memories of sensation as related to motor expression. No attempt is made to separate the various forms of sensory aphasia. As the memory disturbance is directly proportional to the number of association nerves that are severed, "*all* memories reside in *every* part of the association systems." Disorders in the prefrontal part of the cerebrum, however, result in a different kind of loss of memory, a disintegration of the character or personality, especially of reasoning and judgment.

As the phenomena of thought, imagery, and hallucination depend on responses to representative attributes or symbols, these are next considered. There is first the direct representation by means of attributes and their relations in which sensory impressions are correlated with memories of similar impressions. Upon re-representation

the attributes may no longer be recognized, whereupon the representation becomes a symbol, there being no definite line of demarcation between the two. A symbol, being thus an abbreviated form of representation, allows one to respond to the whole situation by a single reaction instead of to each of the details by separate reactions. The result is a great saving in energy and time. The whole course of evolution, accordingly, has been toward a greater use of symbolism as can be seen from the development of writing, gesture-language, and spoken language. The latter is discussed in some detail with a good summary of the interjection and imitation theories. The basis for the development of symbols is considered to be the conditioned reflex, although there are some inherited responses such as sucking movements to foreign bodies or the startle response, a general immobilization of joints preparatory for aggression or escape. Most of our reactions, however, are acquired, and a response to one stimulus such as an ax takes place in the presence of another stimulus such as the urge for cutting down trees, which in turn may take place in the presence of another stimulus as the urge to build a dwelling. In this way one conditioned stimulus may become effective in the presence of another one and make chain reflexes possible. No account is taken of the fact that the formation of conditioned reflexes has special difficulties and conditions. Symbolism is also used to explain illusion and delusion, the difference being in the disbelief or belief in the symbol actually representing what it appears to represent. According to this view, pictures and statues would be either illusions or delusions.

Coming next to the discussion of thought, imagery, and hallucination, it is pointed out that all three have similar characteristics, although sensory activity is increasingly inactive, disorientation in the present surroundings is increasingly great, with increasingly vivid and inaccurate reproductions of objective experiences, as we pass from thought to hallucination. Thought may be vague in definiteness of outline and color, but the relations involved in the concept are clear and definite. With images, sensory reception becomes largely inactive; outlines, colors, and sounds re-experienced, approach the vividness of sensations, but errors in relations appear. With hallucinations, these tendencies are exaggerated. In addition, the destruction of a sensory area may result in experiences with vivid but inaccurate recalls as in dreams or hallucinations. These hallucinations consist

of the elements of sensations lost by the injury. Destruction in the association areas, however, do not result in hallucinations, but rather in loss of parts of memories with disorganization of the rest.

At first sight it might appear that the discussion of epilepsy, which is considered next, would be out of place. But Rosett ties it up with his previous discussion and also shows that the same pattern is present in epilepsy, attention, and sleep. The first stage of the epileptic seizure is a disorientation often with dizziness and premonitory symptoms, which are due to a reduction of sensory reception. As the sensory part of the pathway becomes extinguished, the next or association part is activated, and as there is a lack of sensory guidance distortions of experience amounting to hallucinations are apt to occur. Then the association part is inactivated with increase in the thalamic emotional factor followed by unconsciousness. As the individual becomes unconscious the skeletal muscles become rigid, due to the failure of the cerebrocerebellar nerve system, followed soon after by the clonic movements of the convulsion as the efferent part of the path becomes activated. Finally the efferent part becomes inactivated with loss of tonus and tendon reflexes. Upon recovery there is a reverse order. Tonus improves, movements occur, dreams are common, confused receptions occur, and finally complete orientation. If the wave of disability does not go all the way, we have the minor forms of epilepsy. Even the startling reaction is an epileptoid reaction with disorientation, occasional loss of consciousness, inappropriate acts and trembling.

Coming next to the state of attention, we find that the organism is arranged such that those stimuli are effective that have a relation to bodily needs. Even strong stimuli that interfere with the satisfaction of some need are no exceptions as they are apt to be either nocuous or beneficial. As the needs of the body change, attention also changes, accounting for the fluctuation of attention. The physiological basis is the successive exhaustion and replenishment of the energy involved. If the stimuli which dominate attention give responses that are the same as the original stimuli, there is imitation. This mechanism is limited to situations in which there are certain bodily states, so that yawning is not effective in a refreshed and alert person. The reactions that are made are not necessarily identical, as the goal can usually be attained in more than one way with opportunity for learning.

As in epilepsy, there is a wave of disability along the nerve pathway in each state of attention. First there is a reduction in sensory activity with arousal of the associative systems. If the reduction is such as to avoid distractions, but yet not so great as to prevent guidance, the result is thought. If the sensory guidance is completely absent, thought changes into imagery and hallucination, with sleep as the final result. Evidently Rosett lays great stress on this disability hypothesis as being an explanation for many phenomena. It is not entirely clear, however, whether the reduction in sensory activity is a real reduction in activity or rather a reduction in the number of sensory impulses that can distract. It may be that successful thinking does not depend upon reduced sensory activity as such, but upon the avoidance of irrelevant factors at either the sensory or associative level.

Finally sleep itself is fitted into the successive disability hypothesis. After considering some physiological changes during sleep, the evidence indicating a sleep center in the hypothalamus or mesial portion of the thalamus, and the rôle of exhaustion and fatigue, Rosett differentiates the stages of sleep somewhat more completely than the previously discussed functions. In the first stage, the sensory apparatus is reduced with an increase in the activity of thought. During the second stage, the receptive apparatus is reduced further with thinking shifting into vivid imagery. In the third stage, the receptive apparatus is almost extinct with images changing into dreams and hallucinations. In the fourth stage, the reception apparatus is eliminated with motor phenomena appearing. These consist of startles which often awaken the sleeper and which probably cause dreams of falling. Also tendon reflexes are increased. In the fifth stage, the person is unconscious, the muscles become flaccid, and tendon reflexes are suspended. During awakening the reverse procedure takes place as in epilepsy.

While this theory appears to have a great deal of evidence to support it, at times there appear to be situations that do not fit in and others where some forcing is necessary. The rôle of the thalamus as a sleep center has no connection with the theory, and it is quite probable that the various stages are not so clear cut as indicated. In addition; there are many occasions in which there is no jerking or other increase in motor activity. It is more probable that such phe-

nomena are due to the cerebral motor centers being reduced in activity earlier than some of the lower centers. Moreover, no explanation is given of how the reduction in the activity of one part of the nervous system can increase the activity of another part. While the work is valuable because of the many suggestions for further work, it probably would have been more useful if it was not limited by its behavioristic approach. Rosett has been greatly influenced by Pavlov and the behaviorists of 20 years ago, with no hint of a knowledge of Gestalt psychology. The result is a work that could have been improved by a more dynamic approach.

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BOOKS RECENTLY RECEIVED

(There will always be two pages of book titles, listed in the order of receipt, i.e., the most recently received books will be found at the end of the list.)

GRAEBNER, I., & BRITT, S. H. Jews in a Gentile World. New York: Macmillan, 1942. Pp. 436.

SHAFFER, L. F., GILMER, B. VON H., & PORTER, J. M. Experiments and Demonstrations in Psychology. New York: Harper, 1942. Pp. 230.

AMERICAN YOUTH COMMISSION. Youth and the Future. Washington, D. C.: American Council on Education, 1942. Pp. 296.

HAMILTON, P. Hangover Square. New York: Random House, 1942, Pp. 308.

LUNDBERG, G. A. Social Reseaich. New York: Longmans, 1942. Pp. 426.

KROUT, M. H. Intioduction to Social Psychology. New York: Harper, 1942. Pp. 823.

HATHAWAY, S. R. Physiological Psychology. New York: D. Appleton Century, 1942. Pp. 335.

SORENSON, H., & LEMON, A. C. Workbook for Psychology in Education. New York: McGraw-Hill, 1942. Pp. 178.

BOWMAN, H. A. Marriage for Moderns. New York: McGraw-Hill, 1942 Pp. 493.

CONTRIBUTIONS IN HONOR OF L. M. TERMAN. Studies in Personality. New York: McGraw-Hill, 1942. Pp. 333.

MORGAN, J. J. B. Child Psychology. New York: Farrar & Rinehart, 1942. Pp. 588.

COLE, L. Psychology of Adolescence. New York: Farrar & Rinehart, 1942. Pp. 660.

PRESTON, R. C. Children's Reactions to a Contemporary War Situation. New York: Teach. Coll., Columbia Univ., 1942. Pp. 96.

BENDER, I. E., IMUS. H. A., ROTHNEY, J. W. M., KEMPLE, G., & ENGLAND, M. R. Motivation and Visual Factors. Hanover, N. H.: Dartmouth College, 1942. Pp. 369.

COMPTON, K. T., TRULLINGER, R. W., & BUSH, V. Scientists Face the World of 1942. New Biunswick, N. J.: Rutgers University Press, 1942. Pp. 80.

SEASHORE, R. H., *et al.* Fields of Psychology. New York: Holt, 1942. Pp. 643.

STRAIN, F. B. Sex Guidance in Family Life Education. New York: Macmillan, 1942. Pp. 340.

LEWINSON, T. S., & ZUBIN, J. Handwriting Analysis. New York: King's Crown, 1942. Pp. 147.

BURGESS, E. W., WARNER, W. L., ALEXANDER, F., & MEAD, M. Env. onment and Education. Chicago: Univ. Chicago, 1942. Pp. 66.

SIMMONS, L. W. Sun Chief: The Autobiography of a Hopi Indian. New Haven: Yale Univ. Press, 1942. Pp. 460.

MACIVER, R. M. Social Causation. Boston: Ginn, 1942. Pp. 414.

MANGAM, W. D. The Clarks: An American Phenomenon. New York: Silver Bow, 1941. Pp. 257.

ALLPORT, C. W. The Use of Personal Documents in Psychological Science. New York: Social Science Research Council, 1942. Pp. 210.

PILLSBURY, W. B., & PENNINGTON, L. A. Handbook of General Psychology. New York: Dryden Press, 1942. Pp. 400.

MILLER, J. G. Unconsciousness. New York: Wiley, 1942. Pp. 329.

SCHILDER, P. Goals and Desires of Man. New York: Columbia Univ. Press, 1942. Pp. 305.